No. 84. JULY, 1895. Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor Founded 1888. W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

WASHBURN & MOEN M'F'G. CO.

WORKS:

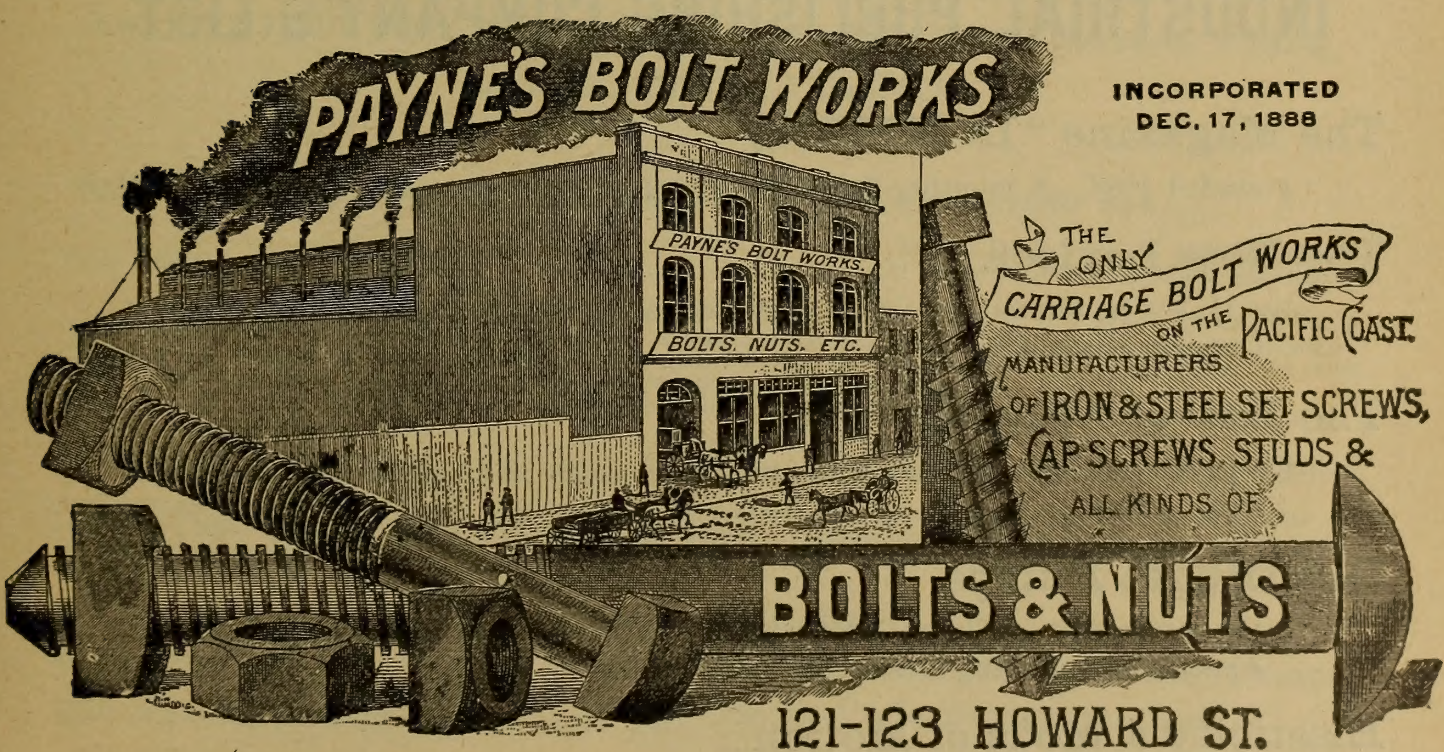
WORCESTER, MASS. WAUKEGAN, ILL.

BARBED WIRE.
BALE TIES.
WIRE ROPE.

IRON AND COPPER
BARE AND INSULATED
ELECTRICAL WIRES.
WIRE SPRINGS.

SAN FRANCISCO
OFFICE AND WAREHOUSE: **8 and 10 Pine Street.**

FRANK L. BROWN, Pacific Coast Agent.

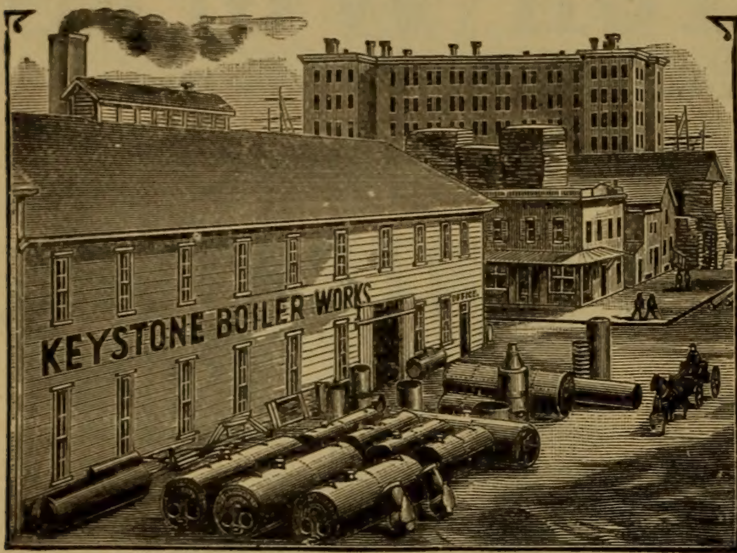


Upset Bridge Rods, Truss Rods and Anchors, Turnbuckles, Head and Point Drift Bolts, Wine Cask Bolts with Brass Acorn Nuts, Cold Punched Square and Hexagon Nuts.

All Kinds of General and Special Blacksmithing

JAS. HAMILTON. WM. LEACH.

KEYSTONE BOILER WORKS



HAMILTON & LEACH, Prop's.

MARINE AND STATIONARY

BOILERS

IRON TANKS, and PLATE IRON WORK

Repair Work Promptly Attended to

OFFICE AND WORKS:

Cor. Main and Folsom Sts.

San Francisco

W. T. GARRATT & CO.

MANUFACTURERS OF

Pumping Machinery

ESTIMATES FURNISHED ON EVERY KIND OF PUMPING PROPOSITION.

Complete Line of Valves, Cocks, Pipe and Fittings Carried in Stock.

EVERYTHING FOR WATER, GAS AND STEAM.

Office, Fremont and Natoma Streets
Works, Fifth and Brannan Streets } **SAN FRANCISCO**

ESTABLISHED 1860.

H. N. COOK BELTING CO.

Tanners and Manufacturers of

PURE OAK-TANNED

LEATHER BELTING

Patent Differentially Stretched

Cook & Houston, Patentees, 1895.

Office and Belt Factory

317-319 MISSION ST., S. F.

Eastern Agent:

L. J. SCOOFFY, 304 Broadway, N. Y.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. JULY, 1895. NO. 84

THE MECHANICS' INSTITUTE EXPOSITION, 1895.

The Mechanics' Institute will hold its 28th Industrial Exposition, in the Pavilion on Larkin Street, in this City, commencing August 13th and closing September 14th. The building, which covers about four acres of ground, will be re-arranged and embellished for the exhibition.

The Board have wisely provided on this occasion to meet and disarm a common and reasonable criticism in respect to the mechanical phases of the Exhibition by appointing Mr. W. H. Smyth, a well-known engineer and mechanic, to superintend this section, and particular attention will be paid to this department, which is ostensibly the main one of all.

These expositions are to promote the mechanic arts, inventive and industrial, also to show the products and natural resources of the Coast.

The chief attraction in the coming exhibition is to be in the installation of various kinds of machines and operations at the Pavilion in the same manner as such work is carried on in the shops and factories, a novel and appropriate idea, which Mr. Smyth explains has met with complete approval in the various establishments invited to prepare these working exhibits.

The scheme is entirely practicable, and if carried out in the manner and to the extent proposed will be a marked departure from the

routine of such exhibitions. People are curious respecting various processes of manufacture, things they have in a regular way no means of observing, and this interest is universal with all ages and classes, but most of all, it is in direct harmony with the purposes of the exhibition.

There is one feature of this and other exhibitions that deserves careful consideration on the part of the directors, a reform that the present case will readily permit, that of omitting awards of medals and the like. We have consistently for twenty years past opposed in every way possible this useless and contentious custom, that has done more than anything else to create prejudice and indifference.

Looking at the matter logically, such exhibitions are not like a wrestling match, or a football game, in which there is contention for a prize. They are, or ought to be, something more intellectual and dignified than a prize system permits. Comparisons, if to be made in the various arts to be represented, should not be judged as between the exhibitors, but in respect to the general state of the arts represented.

We are certainly well enough informed on this Coast to judge of the general merit of industrial exhibits without instituting comparison between "Jones and Brown," both of whom may have equally meritorious exhibits, but not comparable, or they may have exhibits not creditable in the state of the art, but meritorious in other respects. The merit of an honest effort goes for something, besides the distinctions on which prizes or medals are awarded are generally a myth by all definable rules.

Suppose, for example, an award is to be made for ore-crushing apparatus, of which there is an endless variety adapted to various ends and purposes. Who can judge of such exhibits to the extent of granting a medal to some particular exhibitor? A pig, a horse or a pumpkin may be judged intelligently, because these things are uniform in nature, and not the product of personal skill, but even in that case there is no need of a "prize," which is of little value to the exhibitor, and is offensive to every one else.

Popular opinion has for many years been approaching that point where premiums and prizes will have to be discarded, and in the case of the Chicago exhibition reached what may be considered the culminating point. The prizes have not been awarded yet, and perhaps never will be; certainly never should be.

Any kind of a prize is an accomplished fact, commonly used for advertising purposes, and to disparage competing exhibits; stirs up

rivalry, hard feelings, and is unfair on many grounds. The judges may be mistaken in their "opinions," but their decisions cannot be argued or even amended. A medal or other prize is a matter of fixed record.

Some firms of high standing refuse to enter their products for competition in such exhibitions, and in so doing gain a good deal more than a medal or diploma is worth. We suggest that the directors of the Mechanics' Institute, as an experiment for this time, put their exhibition on its merits, and omit all kinds of awards that invite invidious comparison and the consequent results. There can be judges, and awards in the way of criticism and commendation without comparison and jealousy.

No one better understands these matters than Mr. Smyth, the mechanical superintendent, and if he needs aid in promoting some other than the medal and prize system, he will find such support from the principal engineers and mechanics of this City. He suggests that each exhibitor should file or present his own views of his exhibit, and this is a very good way of informing the judges, who often need a good deal of informing. A firm or company that has for months studied over the subject of their display and the points they want to present, are certainly best qualified to give information concerning these points. It is a method sometimes followed, that of filing "claims" to be considered by judges.

Since the above was in type Mr. Smyth has furnished the following transcript from rules for governing the exhibition, for which we are glad to furnish room.

In view of the universal dissatisfaction with the methods of judging exhibits employed in exhibitions, not only of the Mechanics' Institute, but of others of much greater importance, it has become apparent that either displays for competition must be entirely abandoned, or some scheme of judging be devised which shall obviate the serious fundamental errors of present systems.

The evils of the methods at present in vogue are so glaring that a large number of the most prominent and representative manufacturing firms who are large exhibitors have for some years refused to enter their displays for competition, and this notwithstanding the fact that their manufactures present the advanced state of the art in their line of industry.

The position taken by these exhibitors is clearly not caused by fear of competition, but is a practical protest against the methods of arriving at judgments, as it is self evident that no greater benefit could be conferred upon any progressive manufacturer than to point out wherein he falls short of the best practice.

The Committee on Management, appreciating the importance of this sub-

ject, have devoted to the matter much thought, the result of which is the system which will be used at the 28th Industrial Exposition.

It is based upon the following principles:

1st. Every exhibitor is anxious to have his exhibit indorsed by competent judges, and the fact of its superiority over competitors acknowledged by unprejudiced experts.

Some form of competitive examination is therefore necessary.

2d. Competing exhibits, though designed for the same general end, are seldom constructed on identical principles, or approach their object from the same point of view.

Equitable comparison one with another is consequently impracticable.

A universal standard, against which all exhibits of whatsoever character can be judged, becomes a desideratum.

3d. Such a standard is easily obtainable in the present state of the art.

The state of the art is to be understood to mean the construction, method of operation, or result, which by the concensus of the opinion of those engaged in the industry in question is the best present practice.

So the state of the art is adopted as a standard with which every competing exhibit is compared.

A knowledge of the state of the art is presumed in judges.

4th. The present state of the art is for the purpose of judging considered perfection, and is therefore represented by 100.

As each exhibit falls short from this standard, so the percentages accorded by judges are indicated.

5th. Certain fundamental qualities are common to all exhibits.

One such is the efficiency of the exhibit to perform the object for which it is constructed.

Another is the beauty and correctness of design.

Another is the skill and finish displayed in the workmanship.

Lastly, the taste and general appropriateness of the mounting of the display.

Each of these qualities is therefore made subject for comparison, to which points and percentages are accorded.

6th. Personal prejudices may effect equitable judgment.

Judges are therefore instructed to give reasons for exceptionally high or low percentages.

To eliminate the effect of personal bias or prejudice the average of the per cent. accorded to an exhibit by all the judges constitutes the status of that exhibit.

7th. In committee work as aggressive personality sometimes carries more weight than discriminating judgment, it is therefore arranged that judges shall not consult each other, but act alone.

The system of judging adopted is as follows:

Each judge is supplied with a ruled form for entries. In the column "Exhibit No." is a list of the exhibits which he is to judge with respect to their efficiency, design, workmanship and display, as compared with the present state of the art as the judge knows it, he marking in the various columns opposite to the number of each exhibit the percentage to which in his

opinion the exhibit is entitled for the qualities with which the column is headed.

When each judge completes his inspection and marking of percentages, he must hand it to the proper officer appointed to receive it, who will see that it is signed by the judge, he will then enclose it and seal it in an envelope bearing the judge's name. At the proper time this officer will open all the envelopes, tabulate the percentages of all the judges, adding together the percentages accorded by them to each exhibitor, this result will then be divided by the number of acting judges, which will be the average judgment. The exhibitor who receives the highest average per cent. will of course be the successful competitor.

THE REDHEFFER PERPETUAL MOTION MACHINE.*

BY PROFESSOR HENRY MORTON.

In the museum of the Franklin Institute, at Philadelphia, is a curious model, which was made about eighty years ago, by Isaiah Lukens, for the purpose of exposing the fraud involved in the (then) famous Redheffer Perpetual Motion Machine, in which large sums of money were sunk, as they have been more recently in the "Keely Motor," and like schemes.

This model consists of a horizontal circular table, attached to, and supported by, a central vertical shaft, resting on a pivot below and steadied by a journal held in a framework above. Two inclined planes, mounted on wheels, rest on this circular table, and each inclined plane has on it a car containing two removable weights. The inclined planes, and also the cars, are attached to levers which are supposed to transmit to the central shaft the tendencies of the inclined planes to run from under the cars, and of the cars to run down the inclined planes, and these tendencies are supposed to cause rotation of the central shaft, carrying with it the table and all the parts on it.

A model identical in appearance with this, was for many years exhibited in the Philadelphia museum, but was destroyed when that museum was burned down. In that model, if the weights were taken out of the cars, the machine would come to rest, but would start up again as soon as they were replaced, and under favorable conditions would continue to run indefinitely.

Here is a phenomenon which might well startle a novice, but he would do well to hold fast to his faith in the conservation of energy,

*Reprinted from the *Journal of the Franklin Institute.*

and to insist on a further investigation into the interior of the apparatus; for this is what such an investigation would reveal.

A train of clock-work, driven by a spring, was concealed in the base of the machine, and could be wound up by a slight movement of one of the ornaments on the frame of a glass case, which covered and *locked up* the model beyond seeming possibility of tampering. This clock-work drove a small plate, on which rested the pivot of the central vertical shaft, and the various frictions were so adjusted, that when the cars were loaded, the weight thus added would increase the friction of the little plate sufficiently to drive the shaft, but when the weights were removed, this friction was too slight. An attendant, touching the outside case for a moment, once a day, under the pretense of dusting or the like, could keep the spring wound up perpetually.

Such, then, is the structure, and such the mode of operation, of this very ingenious model, whose history, which is also extremely interesting, I will now give.

In the year 1812, Mr. Charles Redheffer applied to the Legislature of Pennsylvania, for a grant of funds to carry out his great invention of perpetual motion, and a committee of experts, consisting of Messrs. Henry Voight, Robert Patterson, Nathan Sellers, Oliver Evans, Archibald Binney, Louis Wernwag, Josiah White and Samuel D. Ingham, was appointed to examine the matter.

The machine to be examined was set up in a building near the banks of the Schuylkill River, in Philadelphia, and on a day appointed, the above named commissioners went out to inspect the apparatus, Mr. Nathan Sellers taking with him his son Coleman, afterwards the father of Prof. Coleman Sellers, E. D.

When the Commissioners arrived at the place, they found that the door of the room containing the machine was locked, and the key missing, so that their study was confined to an inspection of the apparatus through a barred window.

Even this limited view, however, was enough for the sharp eyes of Coleman Sellers. The machine had a set of teeth on the periphery of the rotating table, which geared into another wheel, whose axle was supposed to transmit the power to some other point where work was to be done.

Young Sellers, looking through the window noticed that the faces of the teeth in the two wheels were polished by wear *on the wrong* sides.

Satisfied by this observation, as to the fraudulent character of

the Redheffer machine, Mr. Nathan Sellers concluded that others might be best satisfied by a sort of homœopathic object lesson.

He, therefore, went to Mr. Isaiah Lukens, a very skillful mechanician of that day, and had him construct a model. This he exhibited at first to a number of persons, including Mr. Redheffer himself, but without explaining its true "inwardness." Mr. Redheffer was so impressed that he privately offered Mr. Sellers a large share of his inventions if he would tell him "how it was done." It is hardly necessary to say that this offer was declined, and that in due time the true *modus operandi* was made public.

This matter is in many respects so curious, that I will here insert a copy of the resolution, under which this commission acted, viz.:

"WHEREAS, The interference of the Legislature of Pennsylvania in causing an inquiry to be made relative to the perfection or imperfection of newly-invented machinery is not without precedent;

"AND WHEREAS, It has been represented that Charles Redheffer, of the County of Philadelphia, has invented a machine declared, not only by the inventor, but by many intelligent persons, to possess the power of self-motion;

"AND WHEREAS, Should it be ascertained that these opinions are correctly founded, not only great honor would be conferred upon the Commonwealth, but incalculable advantages would be derived from the invention by the people of the United States especially, and by mankind in general;

"AND WHEREAS, On the other hand, should the machine be found to be imperfect, the public interest would be promoted by exposing its fallacy;

"AND WHEREAS, The Legislature of this Commonwealth reposes confidence in the integrity and qualifications of Henry Voight, Robert Patterson, Nathan Sellers and Oliver Evans, of the city of Philadelphia; Archibald Binney, Louis Wernwag and Josiah White, of the county of Philadelphia; and Samuel D. Ingham, of the county of Bucks.

"*Therefore Resolved*, By the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, that Henry Voight, Robert Patterson, Nathan Sellers, Oliver Evans, Archibald Binney, Louis Wernwag, Josiah White and Samuel D. Ingham be, and they are hereby, requested to make a strict examination of the machine invented by Charles Redheffer, and to make specific representation respecting it, as its alleged importance and the public expectation require.

"*Resolved*, That the Secretary of the Commonwealth be, and is hereby, requested to transmit a copy of the foregoing preamble and resolution to each of the persons named therein, and also to Charles Redheffer."

This resolution passed both branches of the Legislature, and was signed by their respective officers, Dec. 14, 1812.

Then follows the certificate of the Deputy Secretary, and his letter to Nathan Sellers.

In the "History of Philadelphia," by Scharf and Westcott, Vol. I, it is stated that, on November 26, 1812, City Councils appointed a committee to examine into the Redheffer invention. It is also stated that January 21, 1813, was appointed for the examination of the machine, but, before the day mentioned, Redheffer notified the committee that it would not be convenient for him to be present; afterwards he said that he would not show the machine at all, and this being reported to the Legislature, the committee was discharged.

The champion of Redheffer in the public press of that day was the *Aurora*, as in more recent times the New York *Herald* was of Keely.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO."

No. XXXI

A CRACKED COUNTRY.——IMAGINATIVE HISTORY.——A STORM FACTORY. EUROPEAN DRESS.——A MISTAKE IN HOPS. THE NORMAL LINE.

——There is a strange mixture of land and sea in this country, about Puget Sound, and not only here, but all the way to Alaska. It seems that there was an oversight in the geographical make-up of this Coast, there being no harbors from here to San Francisco, nearly a thousand miles down the Coast, and the whole harbor accommodation that should exist, is concentrated here in the Sound.

Some recent writer says all these water-ways about the Sound are "fissures," and proves it too, by sections, profiles and words, that is, shows that the configuration is not that produced by water errosion, but by convulsions of nature, that cracked the country into fissures that filled up with water, some of them wholly, others partially.

This is a novel theory to fit over four thousand square miles of water-ways, sometimes called the American Mediterranean, and has for proof the extraordinary fact that the depth of the water is very uniformly in proportion to its width, or is just the opposite of basins

or channels formed by errosion. It is a curious proposition, in which the author says all this could be done in twelve thousand years.

My Uncle had, as usual, been looking into the history and affairs of the country up here, and gave me quite a start in it, as follows:

——————"This country," said he, "is the home of old lies. There has been more cock and bull stories told by old navigators that came around here, than belongs to any other new country. The Straits, here called San Juan De Fuca, were discovered, and the first entrance made here, about two hundred and forty-five years ago. De Fuca went home and made up a lot of lies of a very picturesque nature.

"Among other things, the old pirate reported that he had found a northwest passage, that is, a way around the American continent, with other stories about endless gold and silver, a country of riches and rare products, an El Dorado if his story had been true. The desire to astound other people with what one has seen or discovered is an astonishing human trait, commonly explained on the grounds of the narrator's vanity, but my opinion is that it comes from the propensity to deceive, inborn and suppressed only by a higher civilization.

"Another old Spanish navigator, De Fonte, had been here before De Fuca, about fifty years earlier. He prepared the first edition of lies, afterward revised and extended by De Fuca. De Fonte says he met with a Yankee skipper up here and bought from him a chart of the coast, for $10,000, which chart was lost. This I mention as a sample of the old chap's imagination.

"Captain Cook came here before he was eaten on the Sandwich Islands, and told about the first truth respecting the country, but his death prevented such use of his narrative as would have led to intelligent explanation of the country.

"Then came old Vancouver, who sailed up past the mouth of the Columbia River, and declared there was no such a stream, but he by accident tumbled into the Sound here, and then went to work in earnest, and surveyed the whole water line. I suspect he was a Dutchman, at any rate his methods were Hollandish. This was only a hundred years ago. Just think of it, and what one century, the span of longest life for one person, can bring forth."

——————We went over to Victoria, a town that might be called "Metamorpho." There are 20,000 people here now; all quiet, staid, respectable citizens, and there are a good many

characteristics of a British town, but there were as many people here about forty years ago when there was a great "mining boom" on the Fraser River. Then thousands flocked here, from California mainly, a swarming out of the placer mines there, getting bare in that country. Then Victoria was a town of shanties and tents, whiskey, gambling, fighting and turmoil. Now it is just the opposite. A sleepy town they call it, but that is no description. It is not "sleepy," but orderly, and an exception to the rule thereabouts of struggling, noise, disorder and "progress," as it is called.

There is a tolerably large iron works here, and we were much astonished to find the very latest machine tools for plate working, hydraulic punches, shears and riveting machines, all of English make. A set of marine engines of about 800 horse power were nearly done, and a very creditable job in every way. There were some new things here, as one always finds in an inland or isolated works, not things to be described, but the usual "kinks" thought out and invented by men who in the cities would be employing their leisure time at a theatre or beer hall.

About here begins, as my Uncle says, the worst coast in the world for winter weather. "Cape Flattery," said he, "is a storm center where is hatched and sent out the storms that cross the continent and sweep down the coast to the Mexican line. Here the fog begins, and thickens to the northmost point of Alaska. The country up to Sitka may be worth something, but the rest of it nothing, unless for mineral products, and that is doubtful if the climate and other untoward circumstances are taken into account.

"There are no reasons for going to Alaska so long as there are other places open to settlers; I mean, to live there. It affords a grand scenic summer trip for four months, and that is the most of it. There is fish, coal and some timber there, not to mention the poor seals that are butchered to make a stiff, uncomfortable kind of clothing, not half as good or sensible as the Chinese produce with cotton batting and cheap cloth. A sealskin coat is to the wearer what Alaska is to the United States, a matter of ornament. In fact the core and kernel of the whole purchase are two islands, St. Paul and St. George, where the seals are taken, a hundred thousand a year at these places alone."

"Human dress," said my Uncle, "is a mystery to all philosophy. The more civilized we become, the more illogical grows the method of dress. Look at our European and American ideas of the matter. Over your breast, there and up to your neck, only your

underwear. The second most vital part of the human organism left nearly bare to accommodate a breast pin, ornamental shirt studs and a necktie. Around the loins, the vital center of the system, so to speak, there is a tolerably well-devised air pump. Lean forward and then back, and you will find a draught of cold air drawn in and expelled upward along the spine. The Latin branch of our people, many of them, wear a sash around the waist to prevent this air pumping, and enjoy accordingly immunity from lumbago and renal diseases.

"Around on your back there are two buttons. What for no one can explain, but they must be there. I could tell you if it were worth while how these buttons came there, but am ashamed to admit having wasted time to find out. Then there are stiff cylindrical hats, sharp-toed and broad-toed shoes, with much more that admits of no rational explanation, so that sealskin coats after all are not so much of an absurdity."

——————From Victoria we went to Seattle, Tacoma and Portland, noting things on the way, and principal among these was a feverish unrest, and "schemes" of all kinds that seemed to engross public attention. Some time, not very far hence, people will wonder how little they know of what was to take place in the industrial affairs of this country. There is not a man here who will not set down and map out the future of these towns, the Sound country, and if pressed a little he will include the Pacific Coast, and even the rest of the continent in his forecast. One rule applies here as everywhere else, the native is no good judge of the matter. The passing stranger is your best prophet if he be qualified as a prophet at all, and as we are strangers some prophecy is in order. It may not be good prophecy, but it is cheap.

In the first place this Sound country having respect to its natural conditions will become one of diversified and normal industry, much more so than any other part of the Pacific Coast. There is good land, a mild climate, plenty of timber, water and coal, a mixed population, a free intercourse with the world. It is a rich country, capable of thrift, and there will be no tendency to special industries. All will flourish, and happily so, because a manfacturing, cotton, sugar or fruit-growing country, however natural or necessary, is by no means so desirable as one of diversified industries and products.

They raise hops up here, and at a profit, but not a great profit now. About ten years ago there was a failure of the hop growth in Europe and all over the world, except on this Coast. The price

went up to a fabulous rate, more than a dollar a pound, and the hop growers found themselves rich by accident. Not one in ten of them knew what to do with the money they got, and set out to use it in various ways that led to their ruin. One old German, who had enough hops to bring $50,000, said: "What does a Dutchman like me want with fifty tousand tollars? Tat will shpoil any Dutchman, and ruins ter hop pisness, you mind that now." This turned out true. The brewers could not buy hops at the price, hunted up substitutes, and quit using hops to this day, but this was not all. Every one all over the country who had land planted hops, and the next summer the price would not pay for picking.

This story, related by a traveler, amused my Uncle, who saw in the circumstance a text for one of his sermons, thus noted down in my book:

"All human affairs move on a horizontal line, perhaps not a horizontal one, but ascending or descending, regular however, and wherever prices, or anything else, is pressed above this line the same thing must descend equally below to fill out the diagram, so to call it. The space above and below the normal line must be the same. Now this applies to everything of an economic nature, as well as the price of hops. If one man, or a number of men, get very rich, that is, rise above the line in wealth, a corresponding volume of the population must go below the line. One man above, if he is very rich, may send hundreds below, and if hops go up to one dollar a pound, or five times their true worth, call it four points above the line, then they must sink four points below, not four in one year perhaps, but one point for four years. It is a law of nature, and, as I said, is not confined to hops. We see this law at work even in education. In countries where the most learned men have flourished there is a corresponding number below the line.

"The tendency of all natural laws is to equality, and the penalty for divergence is found in this balancing-up process. Two years ago we had attained a culminating point in speculation, extravagance and fictitious values, and began levelling up by sending many products, as well as innumerable firms and persons, below the line. There is no rest anywhere, and blessed little common sense in this struggle for existence. The broad signs of coming disaster are not learned or heeded. We are children in knowledge, and stupid children at that."

(To be continued.)

SOME ROUGH AND READY RULES.

A handy rule to ascertain the capacity of water pumps is to square the diameter of the cylinder in inches, and multiply by 4. This gives gallons per minute for a piston speed of 100 feet per minute, and variations from this are easily computed by multiplying the product above named by the actual speed in feet per minute, and setting off two decimal points. For example, a pump of 8 inches bore moving 85 feet per minute gives by the rule:

$$8 \times 8 \times 4 \times 85 = 217.60 \text{ gallons per minute.}$$

To find the diameter cf a pump barrel to raise or move a given quantity, divide the number of gallons by 4, and extract the square root of the quotient. This, as in the rule above, is for a piston speed of 100 feet per minute, and for other speeds proceed the same as before to multiply by the actual speed in feet per minute and cut off two figures. For example, 324 gallons per minute at a piston speed of 120 feet.

$$120 \sqrt{\frac{324}{4}} = 1080, \text{ or } 10.8 \text{ inches diameter.}$$

To find the area of a pipe to conduct a given number of cubic feet per minute at a certain velocity, multiply the number of cubic feet per minute by 134, and divide by the velocity in feet per minute. This gives the area of the required pipe in inches. For example, 100 cubic feet per minute, velocity 230 feet per minute:

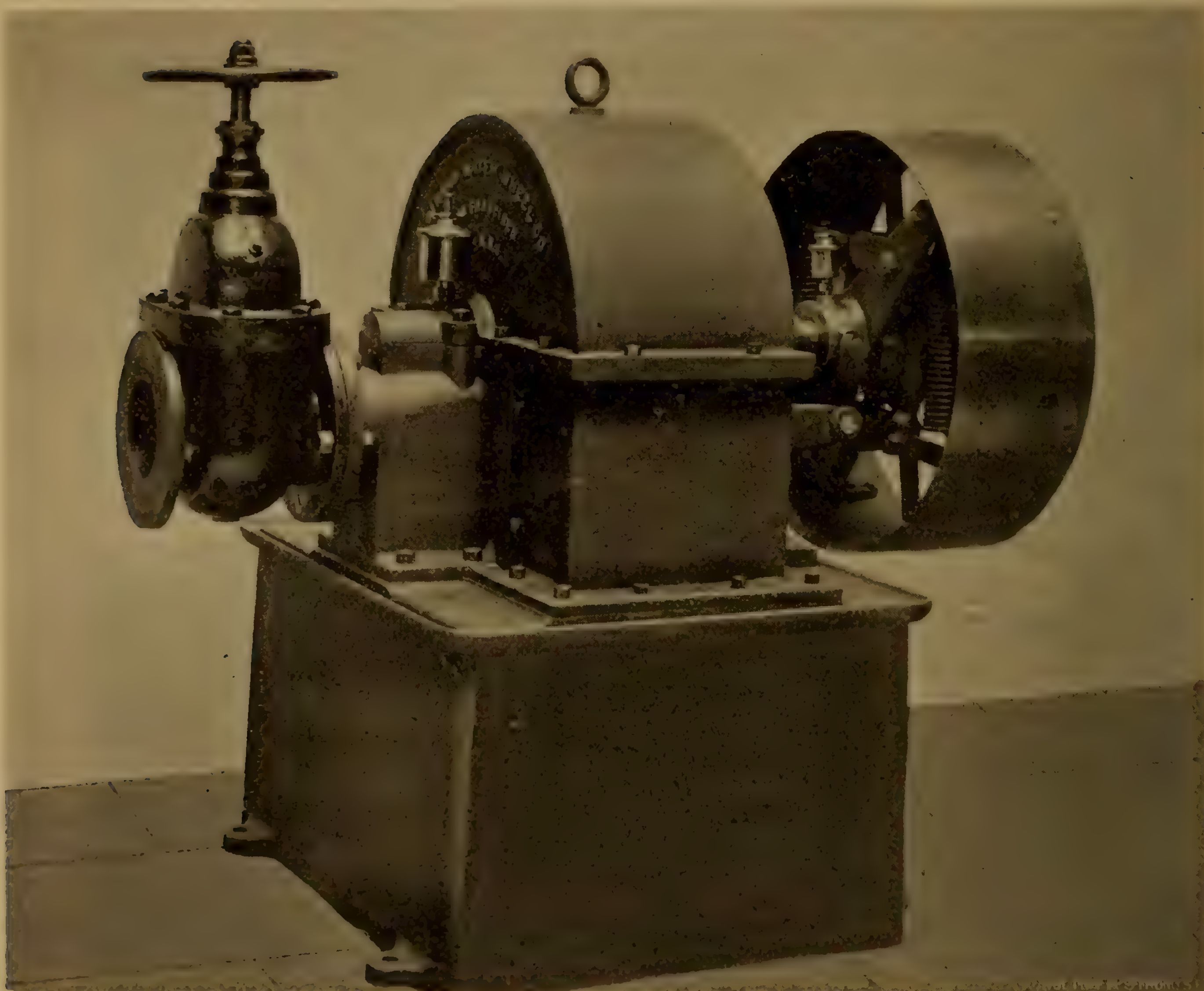
$$\frac{100 \times 134}{230} = 58.26 \text{ inches area, or about } 8\tfrac{5}{8} \text{ inches diameter.}$$

The friction head or resistance to flow in pipes is as the square of the velocity. If, for example, a head of nine feet will drive water at 24 feet per second, it will require a head of 36 feet to drive the same water 48 feet per second.

Professor Merivale, of New Castle, England, has provided a rule for computing pipe friction, expressed algebraically as follows:

$$1.4\ G^2\ h \div (3d)^5 = H,$$

when G = American gallons per minute; h = length of the pipe in yards, H = the friction head in feet.



16½-INCH SPECIAL GIRARD WATER WHEEL FOR A DYNAMO.

THE GIRARD WATER WHEEL CO., SAN FRANCISCO.

The above named company are busy making wheels from 25 to 100 horse power, one pair to generate 200 horse power with 300 miners inches of water on each wheel. The water is applied in ten nozzles, all set within an arc of twelve inches on the wheel, each jet being entirely independent. This shows the flexibility of the Girard system, because on other kinds of impulse wheels of 30 inches diameter 400 inches of water could be applied.

The wheel shown above is a special one made for driving a dynamo where the variations of load are extreme, and the quantity

of water small, but under a high pressure. There are but two jets or nozzles, variable in area or capacity as the work demands, but delivering the water all the time under full pressure.

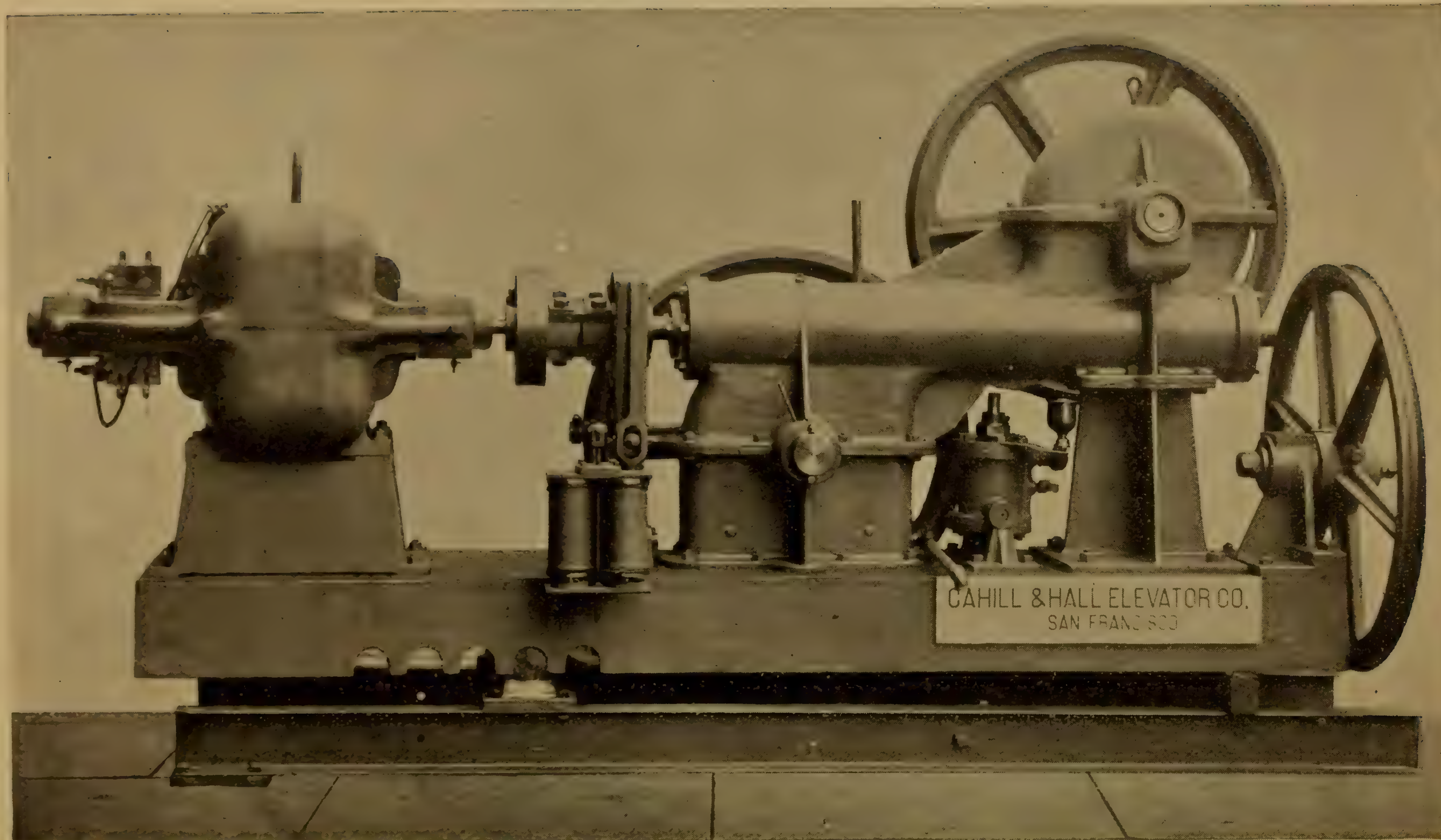
This latter is an important feature in water-wheel practice. A wheel may be tested under a brake or other constant resistance, and give out 80 to 90 per cent. of work due to the gravity of the water used, or, as we may say, give an "efficiency" of this much, but this means but little when compared with the same wheel at actual work under a variable load.

The only way to test fairly the efficiency of a water wheel is to load and unload the brake while the wheel is at work and controlled by the regulating apparatus. In European practice impulse water wheels are made with a number of impinging issues or jets that are "cut out" or applied one at a time by the regulating apparatus.

When a jet is partially closed or "cut out," as the electricians say, its efficiency is to some extent impaired, just how much is not easy to determine, but if the contraction is symmetrical the loss is not more than a third. Assuming this it is easy to compute the losses of regulation under common variations of load.

Suppose, for example, that a wheel is provided with five jets or issues, and that variations of load equals 20 per cent., then the regulator would cut out one issue, and no loss would occur. If, however, change of load is 10 per cent., then one half of one issue would be chargeable with a loss of one third of 9 per cent., that is one ninth of the water would be acting at a loss of 33 per cent., and this loss divided by nine would give an actual loss of only 3.7 per cent., which will be an extreme, because as soon as the regulating issue closes, all the rest are acting with full effect. The real variation would be one half of this. This is very nearly perfect, or is near enough, but with variable issues that preserve their form or contour there is no appreciable loss of effect whatever by variations of load.

We have gone into this matter at some length because it is the principal fact in water-wheel practice at this day, when a large proportion of the wheels made are for driving dynamos, and require complete regulation, as well as an economical use of water.



ELECTRIC TRACTION ELEVATOR GEARING.
THE CAHILL & HALL ELEVATOR COMPANY, SAN FRANCISCO.

ELECTRIC TRACTION ELEVATOR GEARING.

THE CAHILL & HALL ELEVATOR CO., SAN FRANCISCO.

At this time, and a little later than with our friends at the East, there is much activity in arranging and improving electric elevators, that is, elevators in which the winding or operating gearing is driven direct by means of electric motors, the movements being controlled by the current.

One firm in the East, who it is said have made a contract here to supply the new Parrott Building with a number of elevators of the electric type, employ a set of Armstrong pulleys operated by a screw instead of a hydraulic piston, and an electric motor operating the screw. To avoid friction, ball bearings for the screw threads are provided, making as a whole a clumsy machine of large dimensions, and with mechanical devices that have been avoided on this Coast. We have predicted that makers here would produce something better than that, and they certainly have done so.

The Electrical Engineering Company by the aid of their peculiar means of electrical-controlling apparatus have produced some fine examples of direct worm gear apparatus for elevators, and the Cahill & Hall Elevator Company have dispensed with the winding gearing, and adopted a system of traction as shown in the plate on the opposite page.

The sheaves or pulleys seen at the back are for traction, the lifting or suspension ropes pass around these, and from thence over pulleys at the top of the building, the arrangement as a whole being analogous to the method of operating cable railway cars. In this manner the weight of the cables is balanced in all positions, and any number can be used for safety. There are a good many new features resulting from this arrangement.

The power applied is not positive, but will yield if the car or load meets with positive obstruction. The tractive force is dependent upon and regulated by the weight of the machinery, which, as seen, is mounted on a fulcrum near one end of the main frame. This same arrangement provides for a constant and uniform tension of the cables or ropes.

The movements of the main frame on this fulcrum are controlled as to time by a "cataract" contrivance, consisting of a hydraulic

pass-over cylinder, seen beneath the main barrel, the piston being attached to the fixed foundation beneath the machine.

The operating elements are an electric motor, shown on the left, two encased tangent wheels on the axis of the traction pulleys, and a guide pulley set transversely at the end. The ropes, of which there can be two or more, pass once, or if necessary twice, around the traction pulleys, so as to attain the required power, but as before remarked, not enough to prevent their slipping in case of obstruction. The electric elements of the machine, which are especially designed for this work, we are unable to explain.

THE TERMS OF LAW.

The second section of the General Street Law of California reads as follows:

"Whenever the public interest or convenience may require, the City Council is hereby authorized and empowered to order the whole or any portion, either in length or width, of the streets, avenues, lanes, alleys, courts or places of any such city graded or regraded to the official grade, planked or re-planked, paved or re-paved, macadamized or re-macadamized, graveled or re-graveled, piled or re-piled, capped or re-capped, sewered or re-sewered, and to order sidewalks, manholes, culverts, cesspools [gutters, tunnels] curbing and crosswalks to be constructed therein, [or to order breakwaters, levees or walls of rock, or other material, to protect the same from overflow or injury], and to order any other work to be done which shall be necessary to complete the whole or any portion of said streets, avenues, sidewalks, lanes, alleys, courts or places, and it may order any of the said work to be improved; [and also to order a sewer or sewers with outlets for drainage or sanitary purposes in, over or through any right of way granted or obtained for such purpose, provided that whenever the grade of a street, avenue, lane, alley, court or place shall hereafter be changed the petition of the owners of a majority of the feet fronting thereon asking for grading the same to the new grade shall be a condition precedent to the ordering of such grading to be done.]"

To anyone not a lawyer this must appear a juggling with words. If an engineering specification were clothed in such verbiage the author would be laughed at. The parenthetical sentences indicate a poverty of linguistic resources, lamentable if it exists, but it is mere "law talk," the interpolations, no doubt, covering amendments that need not have been made if the original draft had been in the common forms of expression.

Take, for example, the first sentence, or the first three lines, because there are no sentences, "whenever the public interest or convenience may require." This qualifies all that follows, but is indeterminate. What is the "public interest?" The definite article "the" calls for a particular public interest, which is not meant, neither is "public" meant in the true sense of that term.

The "city council" also should by all rules of grammar mean a particular city council, and this is evidently not intended, but the real gibberish begins with the fourth line, where all public area is defined as streets, avenues, lanes, alleys, courts or "other places" of such city. "Other places" must include all the private ground, and all beside, if place is employed in its true sense, and as no city has been described, "such city" is confusing, besides the enumeration of places is incomplete, "lanes, alleys, courts" are indefinite terms in use, and in fact what is meant is ground dedicated to public use no matter what it may be called.

The array of "re-'s" in the fifth, sixth and seventh lines is included in the original words in each case, but even these are unnecessary and confusing, as is the whole down to the word "provided," sixth line from the bottom. This mass of words and re-words means that a council of municipal corporation is empowered to determine the height and form, also to make and maintain the surface and sub-work of all public area within the limits of a municipal incorporation.

A thousand words, with mention of sewers, manholes, capping, piles and walls of "rock," does not make the matter more clear, on the contrary confuses it. "A wall of rock," for example. One would think a "wall of rock" should not need making; neither is "rock" a "material," as any lexicon of the language will show. "Grade" is also incorrectly employed to include height as well as inclination, but is a convenient term, and being thus appropriated engineers have to use "slope" to convey the same meaning.

Now it must be remembered that all this verbiage relates to the "nature" of work, not its character. If the latter quality was included, as it has to be in business specifications, Section II would become a volume, perhaps never end at all.

There is no need of this attempt at dealing with technical terms. The meaning of a law is plain without them, and can be drawn in language that can be easily understood. The redundancy of words, ungrammatical construction and involved syntax of this section is

not exceptional. It was chosen because an enabling one, and of course important.

Section I, which precedes, is also a puzzle if read with Section II. It is as follows:

"All streets, lanes, alleys, places or courts in the municipalities of this State now open or dedicated, or which may hereafter be opened or dedicated to public use, shall be deemed and held to be open public streets, lanes, alleys, places or courts for the purpose of this Act, and the City Council of each municipality is hereby empowered to establish and change the grades of said streets, lanes, alleys, places or courts, and fix the width thereof, and is hereby invested with the jurisdiction to order to be done thereon any of the work mentioned in Section II of this Act, under the proceedings hereinafter described."

A side note informs the reader "what streets, etc., are subject to the jurisdiction of this Act," but it seems all "streets, etc.," are subject to the Act, and the only matter here not included in Section II is a mention of "width," which, as a matter of fact, is not at the control of a municipal council, only to the lines of private property, except by proceedings not defined or referred to.

Subdivision I of Section VII, Act of 1891, reads as follows:

"The expenses incurred for any work authorized by this Act, (which expense shall not include the cost of any work done in such portion of any street as is required by law to be kept in order or repair by any person or company having railroad tracks thereon, nor include work which shall have been declared in the Resolution of Intention to be assessed on a district benefited) shall be assessed upon the lots and lands fronting thereon, except as hereinafter specially provided, each lot or portion of a lot being separately assessed in proportion to the frontage at a rate per front foot sufficient to cover the total expense of the work."

We have read this over, forwards and backwards, without arriving at its meaning, unless it be that railway companies cannot be assessed for improvements not provided for in their charters, which by common experience means that they need not provide anything for the improvement of streets, or the sides of streets they occupy, and the assessments must be levied on private owners on the other side for the whole width of the street. The words may mean this, or may mean something else, who can say?

THE WAR BETWEEN CHINA AND JAPAN.

Of all great wars in modern times this has been the most mysterious. Even on this Coast, nearest to Asia, with direct and regular communication with both China and Japan, with thousands of their countrymen among us, we seem to know less of the causes and portent of the late war than we do of the conquest of Hannibal. The American people do not concern themselves much in respect to the affairs of other countries, especially in Asia, but the present is a case where some careful study may not be without advantage.

There are already rumors, and indeed much more, pointing to an alliance between China and Japan, and when we consider the material advantages that would accrue to Japan in the case of such an alliance there is more than probability of such an ending of the war and strife between these nations. We will not consume space to show how Japan in her present state, with all her energies quickened by victorious war, is capable of leading China into European methods of government, industry and trade. There is here a rich field to occupy, which Japan is too astute to abandon to other nations. She has won the game and will claim the stakes.

Reverting to the causes of the war, it is commonly believed that it resulted mainly from a desire for conquest on the part of Japan, and if so this would be one reason for doubting the possibility of alliance between the Mongol nations. China under such circumstances would be more apt to seek alliance with Russia, but the assumption is not well founded, and we believe the true facts of the case have been more clearly stated by a writer in the *Nation*, No. 1,559, than in any other literature on the subject that has appeared, in the press at least, and we make room for an excerpt from this communication, written in Tokio on the 15th of April last.

"To an impartial observer, Japan has preëminently displayed three qualities in her struggle with her gigantic neighbor. The first of these is the moderation of her conduct towards China in declaring war. It is now known that not Japan but China was the first to contemplate war. As long ago as 1882 the Chinese Government seriously discussed the question of invading Japan and reducing her to a subject State, and Li Hung Chang was repeatedly urged to assume the responsibility of conducting the armies of China against her smaller neighbor. Li Hung Chang was, however, far too astute to undertake the expedition, because he was aware far more than the ordinary Chinese officials that China was in no wise prepared for

such an enterprise. Though these proposals were supposed to be a profound State secret, they were soon disclosed to the Japanese Government, and produced at the time the greatest excitement in military circles. The truth is, China has never forgiven Japan for discarding Oriental in favor of Western civilization. It was only a question of time, therefore, when the Chinese Government would seek an opportunity of revenge against her island neighbor for her recreant conduct, and Japan in turn was resolved to be ready, and possibly even the aggressor in the inevitable contest. On no other theory, except that China has been contemplating war for many years, can we explain the enormous amount of ammunition which the Japanese have found stored away in all the places they have thus far captured. Considering all these circumstances we are bound to acknowledge that the Government of Japan acted with the greatest fairness and forbearance, at least in the preliminary stages of the war.

Not less creditable to Japan, morever, was her complete readiness for beginning the war. Not only did she have her soldiers in perfect training, so far as the appropriations for the army would permit, not only was her navy in a state of great efficiency, but, like the Prussians with regard to France in 1870-71, the Japanese military authorities had a far better knowledge of the state of China than the Chinese themselves. The military maps of China in possession of the Japanese Government are models of excellence when we consider the condition of affairs in China, and the difficulty of getting accurate topographical information. All roads and distances are so minutely drawn, towns and even villages are marked in such detail, that the wonder grows how the Japanese were able to gather all this knowledge in a country with so few facilities for a careful survey. It is evident that the Japanese Government has quietly been engaged for many years in the preparation of these ordnance maps. The military authorities have shown a perfect acquaintance with the position and resources of the Chinese fortresses, their strong points as well as their defects. Without going into detail we may say that the Japanese have shown wonderful knowledge, skill and efficiency, while the Chinese have not understood or appreciated the importance of the simplest defensive tactics.

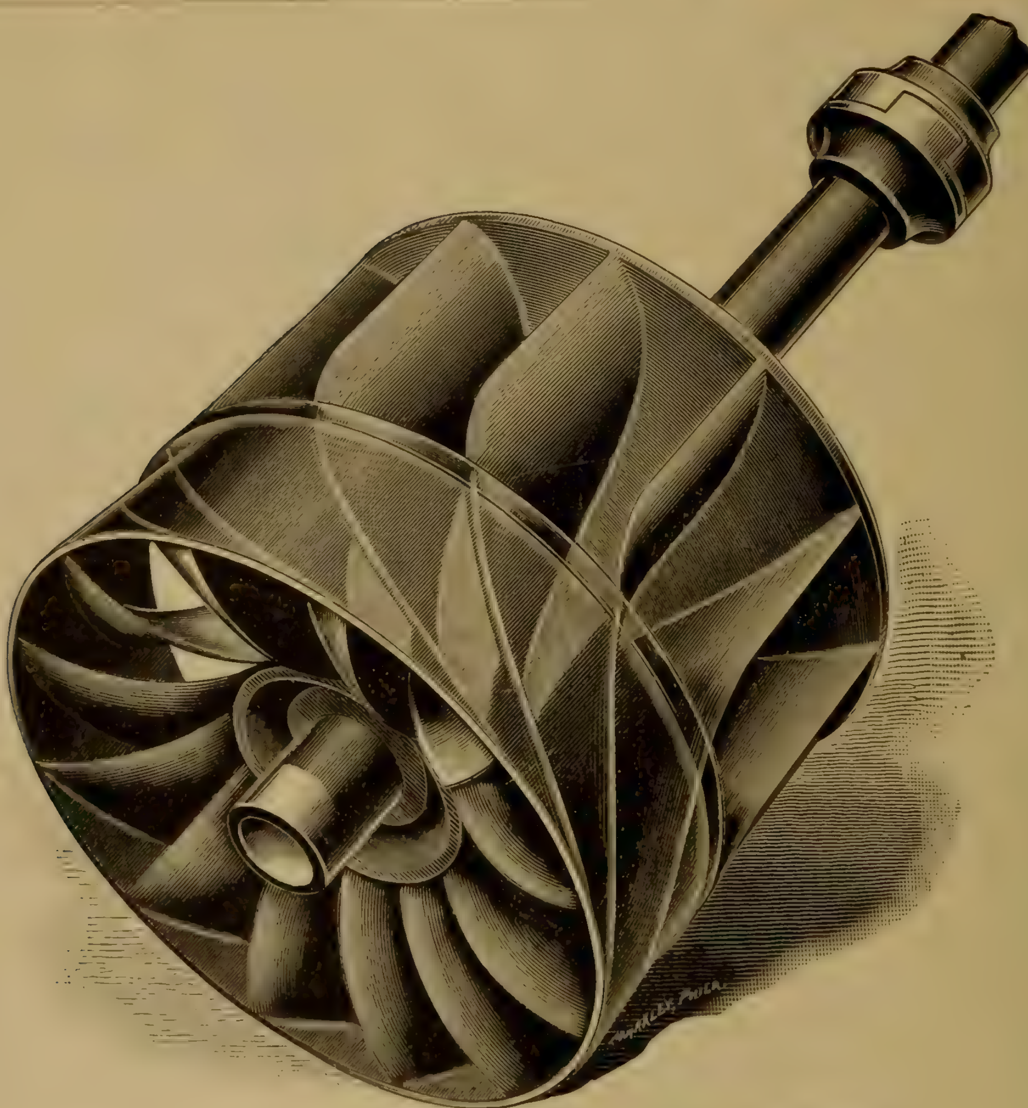
Most important of all, however, in the present war is the thorough organization of the Japanese army and its entire equipment. In some respects the Japanese have advantages for carrying on war even over Western countries in the peculiarly simple character of their civilization. Their commissariat can dispense with many things which in the West would be considered almost necessities. They do not need draught horses, since most of the hauling in Japan is done by coolies, who are strong, active and intelligent, and almost invariably good natured. Good roads are in consequence far less a necessity to the Japanese commissariat than they are in the West. Where roads do not exist at all they can resort to pack horses, a mode of conveyance much practiced in the

interior mountainous districts of Japan. The Japanese artisan is laborious and dexterous. He can quickly adapt himself to new conditions, and with the simplest tools in the world he can make almost any article of ordinary utility. For instance, I have seen five or six Japanese carpenters with perhaps two dozen tools, build a very good house in a primeval forest within a month without resort to machinery or any manufactured commodity, except perhaps a few nails and a small amount of paper. The working classes can sleep comfortably on a straw mat, three feet by six, with a single thick quilt. The Japanese Government has utilized to the fullest extent all these advantages for the army, and especially the commissariat. Even in Tokio, which is remote from the seat of war, tinsmiths may be seen busily engaged in putting up meats and vegetables in small tin boxes (each box containing a single man's ration), of which a certain number are packed in a large tin case. A special body of coolies has been organized by the War Department to transport all the military stores to the railways, and the whole process goes on so quietly and smoothly that the ordinary currents of business and commerce are undisturbed. Indeed, so far as Tokio is concerned it is difficult to imagine that Japan is engaged in war."

At the same time with this we received a letter from a prominent engineer in Europe containing some views that corelate with the opinion and facts quoted, and with the farther opinion that an alliance between China and Japan is most probable, also that such an alliance will mean a menace to the United States and Russia. He says that "a Mongolian invasion backed by 480 millions of people is by no means a pleasant prospect."

We have been busy for some years past in inviting the enmity of China, perhaps in a justifiable way, but a dangerous one notwithstanding. Russia, nearer to the field, and more watchful in her diplomacy, is, as we can well see, putting every obstacle possible in the way of an alliance, and may succeed, but we can rest assured that nothing but a want of readiness, which a few years will bring, prevents Japan and China from requesting Russia to attend to her own business, and let theirs alone.

It is an easy matter to write long and fluent essays on the rise of Mongolian power, and we may look for such in the near future from all kinds of speculative and imaginative people, but the immediate practical aspect of the problem is quite enough at this time, and well explains what we call "Russian interference."



PRESSURE TURBINE WATER WHEEL.

ALCOTT & SON, MOUNT HOLLY, NEW JERSEY.

The Girard Water Wheel Company, who are the agents of Messrs. Alcott & Son, in this City, furnish the above drawing showing the wheel or running element of the Alcott turbines.

As such water wheels are commonly represented by exterior views, no idea is gained of the construction of the issues and vanes, but a drawing as above conveys a complete conception of their construction, except the regulating or inlet issues, and is an exponent, so to speak, of the wheel's action and merits.

As many of our readers as have followed the development of the American inward flow or center discharge turbines, will know that Mr. T. H. Risdon, of Mount Holly, about twenty-five years ago ventured upon certain changes in such wheels that seemed radical and doubtful, also that in public tests at the Centennial Exhibition of 1876, and elsewhere, he succeeded in securing a higher efficiency than was attainable by other pressure turbines, much to the surprise

of many makers, and as we may say, of the hydraulic world generally.

Messrs. Alcott & Son have followed the same methods, and as we believe have absorbed the Risdon works, at Mount Holly, and are producing water wheels of a very high class, with every feature of advanced practice in the various details of mounting, transmission and accessories. We will now proceed to describe as well as possible the peculiarities of these wheels.

It had been the opinion and custom from the earliest times, to cause the impinging or inflowing water to enter hollow or concave buckets, the idea being to confine and intensify the force, or "confine" the water, neglecting in the case of turbines the second or discharge action. The entrance vanes of turbines have been and are now, so far as we know, concave, except in the wheels made at Mount Holly, or copies of them, now to some extent made by others, the patents having expired.

This method of concave or hollow vanes, it has been found, is not the one of highest efficiency, and that the surfaces of entry should be in wheels of this class as nearly as possible normal, or at a right angle to the flow of the water, consequently convex on the receiving faces, as seen in the drawing, and then change gradually to a concave form for the discharge vanes.

To make this more clear, pressure turbines of the American or inward flow type consist of two parts: the upper half being the receiving part and the lower half the discharge part. The upper section is surrounded by the induction issues, and the lower portion enclosed by a hoop or shell, cast integrally with the wheel, and shown transparent in the wheel above, an ingenious expedient here carried out in a very perfect manner by the engraver, A. H. Markley, who for seven years past has made the larger share of original engravings that have appeared in "INDUSTRY."

The Girard Water Wheel Company construct only impulse water wheels for heads of 40 feet or more, and for lower heads supply turbines made by Messrs. Alcott & Son.

We can congratulate the company on having formed a connection with a firm of the highest standing in turbine practice.

Mount Holly is a kind of a suburb of Philadelphia, and machine work done there is of the Philadelphia class, which means a good deal, in cases where the merits of work depend upon the nature of castings. We will in a future number illustrate some examples of these wheels in elevation.

ROLFSON'S IMPROVED DYNAMOMETER.

Mr. R. J. Rolfson, a competent engineer, member of the Technical Society of the Pacific Coast, the inventor of the dynamometer shown above, has conferred a favor on this City by preparing himself to measure power and make dynamic tests. There has always been a large amount of power sold here, and the system of distribution has been much extended of late years by the electric companies. There is also an extensive sale of small motors, steam, gas, water and air, in regard to which there are continual problems, and often disputes, respecting the amount of power sold, generated or transmitted.

Six years ago we urged one of our foremost mechanical engineers to prepare the required instruments and engage in making correct tests of power, but until the present time this has not been done, notwithstanding there is continual and important business of the kind.

We are personally acquainted with Mr. Rolfson, and have had occasion to avail ourselves of his skill in various computations connected with motive power, so attach a good deal of importance to his dynamometric tests.

It is not easy to determine such matters in a mechanical way, and when unconnected with commercial conditions and contracts, and any one called in to arbitrate disputes requires something more than professional skill, they should have an inflexible honesty, and be provided with implements of unquestioned accuracy. This latter remark brings us to Mr. Rolfson's patent dynamometer, of which he sends the following description:

The Rolfson dynamometer consists of the following elements: A brake wheel or sheave driven by the power or work to be measured, an adjustable brake applied to this sheave, mechanism to count the revolutions, circulating water passages to keep the brake, sheaves and clamp cool, and a spring to measure the frictional strain imparted by the sheaves to the clamps and brake levers.

This spring is provided with a dash pot or pass-over piston to prevent vibration, and with a reading scale corresponding to various numbers of revolutions of the brake, sheave or wheel, so the work of a machine or engine being tested can be read off at once without computation. The provision for attachment is very convenient, consisting of a concentric gripping chuck to receive shafts from ½ inch to 6 inches diameter.

The apparatus is a refinement and extension of the Prony brake system for measuring power or work. Its functions and manner of operating are obvious, and easily understood by any one at all familiar with mechanical matters.

The engraving shows a small dynamometer, such as is employed to determine the power given out by small engines or motors of any kind up to forty horse power. These dynamometers are made to order by Rolfson Bros., at 423 Bay Street, in this City.

THE RELATIONS OF AGRICULTURE.

Mr. David Lubin, of Sacramento, has for a number of years past, given especial study to the economic relations of agricultural industry in this country, and as a natural result of such study and

observation, has reached a good many conclusions that deserve careful attention.

Mr. Lubin some time ago, addressed the State Assembly, at Sacramento, on the subject indicated, and his remarks have been printed in circular form for distribution. From this circular we take some excerpts, admitting the injustice of omission, because in all such cases the context is necessary to a fair understanding.

Of England's commercial policy, Mr. Lubin says:

"England's policy, however, has changed all this to our detriment. England being a free-trade nation, desired those factors which would give her the commercial supremacy of the world, and these factors consist in two things—cheap food and cheap raw material. If she could obtain cheap food and cheap raw material, she had the key to the lock which would give her the commercial supremacy of the world, and this she started out to get, and when she succeeded, as she has now, it has a most powerful effect upon the commercial future of this nation. And while we seem to be in hard times now, we have only a trifling taste of what is coming, if this same condition should prevail, or if the same conditions are to continue to accenuate themselves.

English capitalists introduced new labor-saving machines on her immense domains in India, Egypt and Argentine Republic. Finally Russia followed suit, and the result is, that these machines which have preserved this equilibrium heretofore between manufacture and labor in our country (in spite of protection) having been now placed in the hands of the cheapest labor countries of the world, has destroyed the equilibrium.

That staple agriculture has declined to the present world's rate of about one half or less its former rates, is the cause of the economic disturbance. I do not think that you can dispute that, because it is clear and plain to all thinking people."

Of manufactures in Japan, we select the following:

"They came over to England and bought them first-class, A1 cotton plants, with the electric lights and all the appurtenances thereto, and they set them up in Japan. At first they made a few mistakes, but now they understand how to spin cotton. The average pay of a male spinner is 15 cents a day of twelve hours; women earn 6 cents a day. There is a recess of forty minutes for dinner, which is furnished for 1½ cents. Taking the factories all around, three women are employed to every man. The mills are highly profitable, and pay large dividends to their stockholders.

England and the United States used to sell cotton to Japan. There is another city in Japan where this thing has been going on; they opened out with 350 spindles in Osaka, and these 350 have now multiplied to 750,000. We are now living in a new era. The colored man who said "the sun do move" made a mistake, the world is moving, and we are living now in a very peculiar time. It

is the dawn of something that will bring forth a new future, the new civilization, whatever it may be. Perhaps the world, as a whole, may be a gainer; but we must pass through a series of events that may be the most memorable in the history of humanity.

Our agricultural labor-saving machinery, was taken from here to European factories, remodeled, and put into the hands of the cheapest labor countries of the world. In 1884 and 1888, I happened to be in Europe, and went through a number of great plants where they manufactured these machines. It never struck me as anything curious whether the plant was in Vienna, Berlin, Springfield, or South Bend, but after considerable thought the question came up, what are these machines there for? They were not sold to the United States; they were sold to these cheap labor countries, and if you get the statistics for 1893, you find $1,600,000 worth of agricultural machinery was sent from the United States to Argentine, and a much greater proportion was sent from England to the same country.

These machines in the hands of the labor of these cheap countries, have made a terrific difference in our economic conditions here. What will be the conditions when manufacturing machinery also shall be placed in the hands of cheap labor, over 41,000,000 in Japan alone, and so many more millions in China, and with absolutely no restrictions whatever? Our labor must then come down to their level. This is not a question of meeting German, French, or English competition, but it is this new world condition that free-trade England will meet pretty soon. After these cheap-labor countries have absorbed their own markets, they are going to the open gates of the world, and England will be met with the skill of the Japanese using machines.

This is one reason why I am not in favor of free trade. But, if we are to have protection, let us have it exactly as every honest protectionist believes it is today, and that is "protection to American industries, against the cheapest labor countries of the world," so that the man who raises wheat, corn, cotton, tobacco, or other agricultural staples, shall be protected against the cheap-labor countries of the world, as well as the man who makes hats, neckties, shoes and cutlery is protected from the world's competition."

It has been proposed that production of agricultural products should be limited to home consumption, which is the economic theory of our fiscal system, or the only logical one on which it can rest.

In reply to this, Mr. Lubin says:

"Now, why can we not follow that out? Because it can not be done. It is absolutely impossible, and after this was shown to the editor, who reasoned that way—and there was a great number besides, he was amused that he had not thought of it. You see, we buy from the world $800,000,000 worth of goods a year, consisting of tea, coffee, sugar, silk, gutta percha, medicines, manufactures,

and a whole raft of things. We must pay for these. Now, there are besides a couple of hundred millions that we have to pay as interest on foreign loans. But we will take the imports alone. No nation in the world pays in gold and silver. This fundamental or elementary principle of economics I am addressing more to the younger people, and to some young ladies here who have not made a study of economics. You, legislators, know these things to be true. No nation can pay in gold. If we had all the gold and silver in the world, and we paid $800,000,000 away in a year, in a few years we would not have a dollar.

Our manufactures are not sold in foreign countries, except to a limited extent, because they are protected. The nations of the world know better than to buy protected neckties, pocketbooks, or hats, when they can buy them from much cheaper labor countries. It is not because I say it, it is because the official figures say it. Now, if we curtail down and only produce what we need at home, what would we pay with? We would have no gold and silver; they do not want our manufactures. We would pay in notes, but the notes would become due too, and we would have to pay them in gold. The only way we have paid up to date is in staple agricultural products. Of the $834,000,000 paid in 1893, staple agriculture furnished $615,382,986. Do you see it is pretty near the whole business? Now, if we did not have these staple agricultural products to pay with, we would have to pay in gold."

There is one omission, or rather corollary neglected in Mr. Lubin's address, perhaps not pertinent to his present aims, but noteworthy.

In his statement of England's commercial policy, and the enormous drain from this country to meet our liabilities there, it might have been pointed out that these circumstances are directly due to the policy that Mr. Lubin attacks, that of ourselves abandoning the markets of the world, and furnishing England with the elements required to secure the trade.

We must of course admit, that at the present day we are fast being converted to the importance of foreign trade, but it is not long since we were informed in plain words from many sources, among others by a professor of economics, in a Pennsylvania University, that foreign trade was a bad and undesirable thing.

We have moreover "Carey's work" on social economy, written to uphold the same view.

Mr. Lubin's views followed out to their application, leads to "incidence of taxation," and this is certainly broad enough to be responsible. In fact all economic problems lead up to this, and it is in the end a sense of unequal taxation that must be depended upon as the moving incentive for change and reform.

DEMAND AND SUPPLY.

Among the economic sophistries of our time none has been so widely entertained and accepted without evidence or inquiry as that of accounting for prices on the grounds of demand and supply.

Senator Sherman in a speech made last month on the silver problem says:

"The enormous increase of production of silver in the United States, Mexico and Australia has disturbed this ratio, and has lowered the market value of silver precisely as a like increase of production has lowered the price of other commodities. It is a universal law that price or value is measured by quantity."

Here is a direct assumption of the demand and supply theory, ending with the corollary that prices are a result of quantity "by an universal law," and that an increase in the "quantity" of silver mined has directly lowered its value. Commenting on this, one of the daily papers in San Francisco says:

"As the production of gold has nearly doubled within the past two years, we may expect to hear Mr. Sherman say that its market value has fallen one half. If not, why not?"

Mr. Thomas H. Geary in his speeches three years ago had a favorite explanation of the demand and supply theory, illustrated by saying that when two or more men were seeking one job the wages would fall, and when the job was seeking more men the rate of wages would rise. This is true to the extent of fluctuations in the rate of wages, but is by no means a measure of the general rate. Something more stable than that fixes such rates, otherwise it would be a matter of accident, and have no base whatever that would demand corelation in different countries and in different pursuits, as will be shown presently. The three examples given are selected to show common deductions from the demand and supply theory by men who have given some study to economic science, but who have not observed particular facts.

Reverting first to Senator Sherman's, that an enormous increase in production has cheapened the price of silver, and that "quantity" governs prices, it would be very difficult to prove this farther than quantity has diminished the "cost" of production. The mere fact of quantity will not account for the price of silver, or anything else that admits of wide use in the arts, and there is no need whatever of such an assumption when we have the more evident and

logical reason of "cost" measured in labor, risk, time and other elements of production.

In thirty years past it is safe to assume that the cost of mining and reducing silver ores has been reduced one half, perhaps more. New methods have been applied throughout, explosives, pneumatic drilling, hoisting, crushing and reduction have all advanced in a wonderful degree, so that the cost of producing silver has been diminished in the same proportion that its price has fallen, but the quantity produced or the supply is quite another matter, is a sequence, not a cause, as Senator Sherman assumes.

If the cost of producing silver had remained the same since 1860 the chances are that its price would not have varied much. It is not a "law of nature" that price is governed by quantity, but it is a law of nature that price is governed by the cost of production, especially in such an article as silver, that can be used in various arts up to ten times the quantity now produced.

The newspaper corollary, that if the increased quantity of silver lowered its price then a like increase in the quantity of gold should have had the same effect, is a logical argument against Senator Sherman's demand and supply theory, but the analogy is not complete. The production of gold has not been attended with the same cheapening of processes, and even if it had, the volume of production follows a different line.

Beginning in 1855 with a total of 135 millions, there is a decline down through 35 years to 1890, when the product was about 120 millions. With silver the change has been the other way. From 40 millions in 1855 the increase has been to 158 millions in 1890, and more than 100 millions a year since 1880, rising for the next ten years as follows in millions:

1881	1882	1883	1884	1885	1886	1887	1888	1889	1890
102	111	115	105	118	120	124	140	158	158

There are of course various estimates, but the proportion is, no doubt, substantially as above, that is an increase of 50 per cent. in ten years. Granting this, the mere fact of augmented quantity we contend is not the cause of a decrease of 50 per cent. in the price of silver, but the real cause is a change in the cost of production.

It is true the "natural" supply may have had much to do with the cost of production, but this is not what is meant in Senator Sherman's statement, at least there are no reasons for this inference. Perhaps the fairest way to estimate the change that has taken place in the cost of producing silver, respecting which there is

little or no data, is to compare with copper, which is the next in value among the metals in common use.

By referring to the able reports of Mr. Henry A. Robinson, Commissioner of the Bureau of Labor in Michigan, and to various published statements of ten years past, there is no doubt whatever that the cost of producing copper has declined one half during that period, although the ore has been raised from greater depths, and no one acquainted with silver mining will place the cheapening of its production below 50 per cent. during twenty years past.

If the same labor and investment in 1890 will produce 50 per cent. more silver than in 1870, then its decline in price is obvious from a natural and inevitable cause, and quite independent of quantity. It is the law of all commodities, measured in human effort, and what we may call values, such as labor, food, clothing and shelter, or the exponent of these, which is money.

It is in labor, however, where we most clearly detect the error of the demand and supply system. Taking for familiar illustration the working force of a factory; the labor rises through various grades of skill, and wages from one to five dollars a day, and the supply is commonly greatest for the higher-paid grades of labor.

All are struggling in the direction of higher pay, but the supply of men has but little if any effect in altering the scale of rates between the higher and lower branches of work. The wages of draughtsmen may, for example, fluctuate some, but not much. There is a natural rate based upon the skill and earning power of draughtsmen that bears a certain proportion to fitters, pattern makers and clerks, maintained irrespective of supply, and if there were ten men wanting one situation the fact would not much affect the rate of the pay given for their services.

If wages in this case depended on demand and supply, why should not a draughtsman's wages sink to one dollar a day or less? The same rule holds throughout. The rate is based on the comparative value and earning power of service, and will always tend to that gauge whatever the fluctuations may be by reason of supply and demand. This is a natural price for all things, hard to determine sometimes, frequently changed by natural circumstances, sometimes by inventions in methods and process, but not much by accidental demand and supply. The facilities for travel and transportation prevent conjestion from such a cause. Labor, food and clothing flow from one country to another, as water seeks its level, and there is no way of much affecting the prices of commodities by supply, so long as there are uses for them.

CALIFORNIA AND COLORADO STAMPS.

The *Mining Industry*, of Denver, says in respect to stamp mills in Colorado and California:

"The California mill, as generally understood, has a rapid drop and slow discharge, and treats from two to three and a half tons of ore per stamp each 24 hours. The Colorado mill has a high discharge and slow drop, and treats from one to one and a half tons per stamp each 24 hours. This is the characteristic difference in the mills.

It is positively established, that for most Colorado ores the slow drop and high discharge gives the highest saving and most profit. It is said that the opposite is proven for most California ores. We have yet to see the proof of the claim.

Another thing that is proven, or claimed to be proven, is that the slow Colorado method will save more of the gold in the ore than the rapid California method. This saving is placed at from 10 to 50 per cent., each man who goes into this dangerous mathematical ground apparently forming his opinions from his own field of observation, which with all must necessarily be limited within narrow bounds.

The balance of authority seems to be in favor of the claim that the slow method saves the highest percentage of value. The question often resolves itself, then, into this: Will, in any particular case more profit be made by the slow than the fast method?

In one case the California mill may treat three tons each 24 hours, saving $2.50 per ton, at a cost of 50 cents per ton. By adopting the Colorado mill the saving may be increased 10 per cent. or 25 cents per ton. But it may be at an expense of one and a half tons capacity per stamp, and the increased cost may be 50 cents per ton, the result of which would be a net loss of 25 cents per ton.

In most cases the problem seems to resolve itself into this: If the ore is high grade, the increased saving in the Colorado mill more than compensates for the loss of capacity and the increased cost per ton. If it be low grade the increased saving may not be enough to pay the increased cost."

There is something not clear in the differences of stamp construction. On Lake Superior in the copper mines it is considered best to employ enormous direct-acting steam stamps instead of the Cornish or gold and silver system, and we imagine first cost of machinery and foundations has a good deal to do with light stamps.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association held their regular meeting on the 7th of June, Vice-President Curtis presiding, so as to permit the President, Mr. G. W. Dickie, to read a paper on "Engineers: Consulting, Inspecting and Contracting," which will be noticed presently.

The Secretary read a notice announcing the death of a member, E. A. Beardsley, at Phœnix, Arizona. Messrs. Grunsky and Henny were appointed to draft the usual tribute to the memory of the deceased member.

Mr. E. S. Cobb, Mechanical Engineer, of San Francisco, was elected a member of the Society.

Mr. Dickie's paper, as usual with his contributions, contained a good deal of an original nature respecting the ethical and practical relations and duties of engineers in the lines of consulting, inspecting and contracting.

The paper not being at hand we cannot as intended, reprint a portion of it, but will remark that it stirred up a general discussion, the drift of which indicated that engineering work, like all things at this time of ours, but in less degree, had drifted into chaotic lines. Notable, however, as some of the speakers pointed out, in that the profession in all its branches and phases has kept clear of what may be called scandals.

One point in Mr. Dickie's paper was very suggestive, that of maintaining a coöperative relation between inspecting and contracting engineers. In this country, for some strange reason, nearly all official positions are regarded as "antagonistic," from a tax collector up to the President, the spirit seems to be that of "war on the public."

An inspector is apt at the very beginning to set out with the idea of contention, and that he is a spy set at work to watch and curb a contractor, whose purpose is to cheat and evade. This is certainly the case sometimes, but not always, and is frequently a result of the system of inspection.

Mr. Dickie, as manager of the Union Iron Works, has for many years been directly concerned in the performance of large contracts with the government, and his views are those of an experience which others may well profit by.

LITERATURE.

Wheelbarrow on the Labor Question.

The Open Court Publishing Company, of Chicago, have collected and published, with a most interesting memoir of the author, a number of sketches written over the pseudonym above, which will easily be recognized as that of the late M. M. Trumbull.

Preceding the work is an autobiography, one of the most remarkable that the joint circumstances of the new and the old world could produce, a story without a parallel perhaps in annals of the kind.

For this fearless man, and the acumen of his understanding, we have always maintained the highest regard, but the hard lines of pressure in his unhappy youth remained throughout his life, and made him an antagonist, not always with good reason, as in the present work, a half of which is to combat the idea of a single tax on land values, which he claimed was impracticable, when twenty-four hours away, at Philadelphia, the system was a century old, and beneficient in results.

The author is gone, and we do not propose to raise issue with his views in one case, when in a hundred more he has our warmest admiration. The name "Wheelbarrow" was assumed because it was with that implement he labored for a time after he came to this country; then a schoolmaster, a lawyer, public officer and essayist. It is a strange story.

The work contains over 300 pages, and is sold at 35 cents, which seems almost no price at all.

Journal of the Association of Engineering Societies.

April, 1895.

This publication embraces papers presented in about a dozen of the engineering associations in this country, in leading cities from Boston to San Francisco, edited and published in Philadelphia. It represents a scheme to cheapen and widen the circulation of technical papers presented before these societies, and to secure careful revision and classification, which cannot well be carried out by each society.

The present organization embraces: The Boston Society of Civil Engineers; the Western Society of Engineers; the Civil Engineers' Club of Cleveland; the Engineers' Club of Kansas City; the Engineers' Club of Minneapolis; the Montana Society of Civil Engineers; the Engineers' Club of St. Louis; the Civil Engineers' Society of St. Paul, Minn.; the Denver Society of Civil Engineers; the Association of Engineers of Virginia; and the Technical Society of the Pacific Coast.

The organization of the Association consists of a board of managers for each society with a chairman elected by the board, and a secretary who attends to the publication of the journal. This latter office is now ably filled by Mr. John C. Trautwine, Jr., of Philadelphia.

Before mentioning the papers included we must express a regret in finding there is no number of issues, the present one being Volume XIV, No. 4, which is far from defining the place of the publication, which requires its date to identify it. We hope the secretary will change this, and number the issues consecutively from the beginning, eliminating the volume matter, which is of no consequence whatever.

The present issue contains five papers of interest; on the Chicago Canal, Railway Location, Timber Bracing, Education, and Cement Manufacture. Among others one by Dr. C. M. Woodward, of the Engineers' Club, of St. Louis, on *The Relation of Technical to Liberal Education*, is the one that will be most widely read.

We need not remind our readers of the tiresome reiteration of essays, speeches and writings on the subject of "technical training." We have not printed the term for years past. It has been the burthen and song of tyro and professor, with now and then, but most infrequently, a new idea or useful fact, but here is what may be called a "departure."

The fact is that the present essay is the first fair and intelligent explanation of the

difference between the two systems we call "classical" and technical, neither of which terms conveying accurately the intended meaning, and we suspect that Dr. Woodward is almost the first one to write of the matter with complete ability to do so from both sides. We propose to publish the paper if the consent can be had from the Association.

"Self Culture."

THE WERNER COMPANY, CHICAGO.

This magazine, which has for its motto *abuent studia in mores*, emanates from what is called the Home University League, an educational enterprise to promote self study in the higher branches of thought and culture. Our present knowledge of this association or system is not enough on which to form an opinion farther than all educational agencies are good, but in respect to the publication *Self Culture* there is no doubt of its value.

It is, of course, on the academic plan, or academic in character, as popular methods must be, with human progress as the main purpose in view. Twenty pages are given to anthropology, framed in an attractive and instructive form. There is an essay on Eli Whitney's Inventions; the Principle of Evolution in Nature; the Story of the Plague in History, with much other matter, current, statistical and technical.

Price $2.00 a year. The Werner Co., Chicago.

Engineering Magazine.

JUNE 1895.

This magazine, like many other publications, has to be identified by the date of its issue. It is divided into volumes on some basis not known, and the "number" does not relate to consecutive issues, but to some place in a "volume." As far as any practical use, both of these could as well be omitted.

The first article in the number above named is by Mr. Edward Atkinson on the "Malignant Effects of the Free Silver Delusion," which is a strong title certainly, and in a sense inconsistent. A delusion is not malicious. The terms are in fact opposed, and whatever can be said against the silverites, no one accuses them of malice, nor does the term apply to the "effects."

One of the strangest phases of modern literature is the return to sensational and metaphorical titles, such as were employed a century and a half ago. The *Forum* and *North American Review* are especial transgressors in this matter of titles.

Mr. Atkinson writes in a vigorous and thoughtful manner on the money delusions of our time, ending up with the statement that before another Congress meets the favorable conditions of the country will prevent further harm from the silver faction.

Mr. T. A. Eddy, a merchant of New York City, writes of the growth of the American export trade, and cites in an orderly way a large array of facts, as well as inferences, to show that this country is about to enter into export trade on an extended scale. This is good prophecy, but is not new.

The possibilities of American manufactures entering the neutral markets of the world is an old theme, always urged in "INDUSTRY," but is a heretical proposition in the eyes of those who disparage international trade.

Omitting odd thousands, we exported in 1894: agricultural implements, $5,000,000; copper and goods thereof, $22,000,000; cotton manufactures, $14,000,000; wood manufactures, $6,000,000; leather and its product, $14,000,000; coal and coke, $12,000,000; iron and steel manufactures, $29,000,000; oils, $47,000,000. These are the principal items.

Mr. Eddy closes his article as follows:

"We have heard some strange doctrines—ancient superstitions revived — in our days; that commercial intercourse with foreign nations is a thing of doubtful desirability, that importing is sinful, that goods may go out of the country, but only cash should come in; that when an American merchant sends a ship to a European port with a cargo that cost here $100,000, and he sells the cargo in Europe at a profit enabling him to buy a cargo there costing $125,000, and he ships that cargo to South American ports and sells it again at a profit enabling him to buy $150,000 worth of hides and other merchandise to be brought to New York, the balance of trade will be against us $50,000, and the United States have lost that amount. I think the barbarous doctrines I have mentioned do not deserve another word. Let them stew and smother in the depth of their own absurdity."

"Irrigation Surveying in California," by Mr. Charles E. Fowler, describes in a

graphic way a search for mountain snow water to be led by long tortuous and expensive conduits to the plains below. It is hard for any one who has not been in the mountains of Southern California to understand even from so carefully a written description as this the wild and romantic experiences of "running a line" into or out of these cañons, or the desperate expedients that become necessary in conveying water around precipices, over chasms and through spurs by tunnels. The photographs with the present article more than any description explain the nature of the work.

"The Construction of Wooden Stave Pipes" is another article explaining special California engineering practice, written by Mr. Arthur Lakes.

On the whole the present number is an exceptionally good one from all points of view.

Consular Reports.

MAY 1895.

Consul-General Wm. S. Carroll, at Dresden, Germany, sends to the State Department, under date of March 8th, a full description, accompanied by drawings, of the gas motor street-railway cars in that City. This is an exceptionally valuable contribution, as it represents the best practice in Germany in a branch that is receiving a good deal of attention here.

Criticising the design of these cars in a general way, the arrangement is no doubt as complete as it can ever be made. The engine with its gearing and accessories occupies mainly the spaces beneath the seats at the sides of the car, and access is from the outside only, and there is no noise or odor of burnt gas, two things that have in this country been serious impediments. The gas is stored in a tank at a pressure of about 90 pounds to an inch, and the power is transmitted from the engine to the axles by chains working in oil. The cars weigh about 16 tons, carry 36 passengers, all seated, and cost in Germany $3,500 each.

There is a voluminous report from various consular officers on the manufacture of tin plate abroad, that in view of the inventions and processes now in use in this country will not add much to the art in that way, but contains a good many useful suggestions respecting material for plates.

There are also in the May number lengthy and complete reports on baling cotton as practiced in several countries, with this one behind or worst of all, both as to the density of the packages and the coverings. This is curious, to say the least; that in India, Egypt, and even in Turkey, baling should be better done than in the United States.

With this, however, is the circumstances of a new method of baling or packing cotton, on the Bessonette system, at Waco, Texas, where the cotton is rolled into a compact cylinder, the power required being distributed over a long period, and the mechanism proportionately relieved from strain.

It seems the most simple and rational way of proceeding. The shape is better for handling, and the cost is 50 cents less on each bale. The density is 40 to 50 pounds to a foot, compared with 23 to 25 pounds by the old method. The web from the gins is wound around a barrel, afterwards withdrawn, and the cotton is compacted or pressed by rollers that exclude the air as the process goes on.

The only reasons for a rectangular package we can think of are that the presses as now made operate in one plane only, and in stowing cargoes the space is more completely filled than with cylindrical packages.

The Pacific Lumber Trade Journal.

SEATTLE, WASHINGTON.

No II of this Journal, now at hand, gives promise of a very complete and useful accession to the literature of the great timber interest. We had some part in founding twenty years ago the *Timber Trades' Journal*, and almost regret that our contemporary has not assumed the same title, but if the term "lumber" is to mean "timber," the title is relevant and proper.

We take the occasion to suggest that the editor can confer a great benefit on his readers by devoting some space to the methods of converting timber, as well as to the trade. The processes are on this Coast wasteful and imperfect, apparently with but one object in view, which is cheapness both of machinery and product. This is a result of cheap timber and dear labor, but trade circumstances are changing, so must the mills improve the finishing processes.

Cassier's Magazine.

JUNE 1895.

The present is an exceptionally fine number of this magazine, containing a large amount of original matter, including a short article by United States Chief Naval Constructor Philip Hichborn, on "The Care of Steel Ships," a subject that has a foremost place at this time in connection with the vast sea armaments in use and being prepared.

The custom is to dock, clean and paint all iron and steel vessels in commission once in six months, which as an item of expenditure will become a fearful tax as the number of vessels is increased. Constructor Hichborn has been an advocate of sheathing metal ships with wood and copper, depending on the metal for strength and the covering for protection from fouling, and also to some extent from injury, which, by the way, has strong analogy to modern buildings that are made of steel and covered with a weather clothing, to so call it.

Chief Constructor Hichborn is well known on this Coast. He was in California about ten years, from 1860 to 1870, most of the time at the Mare Island Navy Yard as master ship builder and as a constructor.

Most notable among the articles in the present number of the magazine is that of Professor W. F. Durand on "Electricity for Marine Propulsion," which is a logical analysis of the limitations in that direction, and the first we have seen.

Professor Durand does not, as is common, set out to compare an electric motor to a steam engine, which do not admit of any comparison, but contrasts coal with stored electricity. He finds that the electrical outfit, based on eight hours of service, will weigh five times as much as steam machinery, and the first cost will be as 27 to 4, or about seven times as much. These conditions are compensated to some extent by the circumstances of use, which on all points is in favor of electricity; noise, danger, control and convenience being all on the electrical side.

For a launch of six tons and one hundred horse power, prepared for a run of six hours, steam machinery is set down at 8,500 pounds, and for an electric outfit 40,000 pounds. In the same proportion, a vessel of 20,000 horse power provided for a journey of seven days, would require for steam 4,400 tons of steam impulsion plant but with an electrical plant 150,000 tons, or ten times the total displacement of the ship.

These estimates if correct, and they no doubt are in the present state of the art, will be useful to those who expect to see ships "driven across the Atlantic in three days by electricity." The fact is, as all circumstances prove, that electric propulsion is a luxury possible for small vessels intended for pleasure.

A strange proposition is presented by Mr. Killingworth Hedges, C. E., on "Solid Force Transmission," which term he applies to balls confined in a tube or channel impelled like a liquid. The information contained in this article respecting power transmission by air, water and electricity, is its most valuable feature. The ball scheme, beyond very exceptional cases, has, in our opinion, nothing to recommend it.

Water-Tube Steam Boilers.

Mr. C. C. Moore, the agent here at San Francisco, has sent in certain trade publications of the Babcock & Wilcox Steam Boiler Company, in this country and in England, that are a marvel of completeness, and "sumptuous" as an example of the typographic art.

Among other things these publications contain a history of the rise and progress of sectional steam boilers since 1825 that shows a gradual evolution of the system since then. There are certain characteristics that follow throughout, and the race between inventors and makers has been as much to secure constructive advantages as anything else. Certain fundamental impediments exist in the adaptation of such boilers, for example: the hot gases and steam both tend to rise and follow the same course, but theoretically they should go oppositely, that is, the hottest gases should meet the hottest steam. This cannot be done completely, but is no doubt as nearly attained by the Babcock & Wilcox Company as is possible, at least there is not in the endless modifications that appear any nearer or better approach to transposing the course of the hot gases and the steam; in fact this feature of the Babcock & Wilcox boilers is found to some extent in nearly all that have followed during twenty years past

Local Notes.

Last month we had occasion to mention the increase in capacity of gas engines made here, and a second visit to the Union Gas Engine Company's Works shows a farther progress in this direction. There was on the floor parts of a plant, and one completed engine out of four, forming a combination, for a mining company, that will aggre-160 horse power. One of the four engines has been at work some time, with the result that the Company have decided to adopt gas engines throughout. There is also in the works an engine of 80 horse power for a yacht, and a large number of orders for engines from 25 to 40 horse power. It is evident that the limit of capacity for gas engines is rapidly disappearing. Messrs. Sleicher, Schumm & Co., of the Otto Works at Philadelphia, make engines of 100 horse power, and would no doubt undertake greater sizes if required, and the same may be said for makers here.

The Washburn & Moen Manufacturing Company have acquired the California Wire Works at North Beach, in this City, and will operate this property in future as a branch of their extensive business. The main works of the Company, at Worcester, Mass., employ 5,000 men, and a branch at Chicago 2,000 men. The San Francisco Works will make the third manufacturing branch, and will no doubt be operated in a very extensive manner in future. Mr. F. L. Brown, the Company's representative here, informs us that the trade in their products from this City is being rapidly extended into South and Central America, Asia and Australia, but that to keep the works at North Beach in operation will require the home patronage, which will certainly be given under the spirit now prevalent on this Coast. It is more than twenty years ago when we last visited the Washburn & Moen works at Worcester, Mass., but can well remember the public spirit which then, as now, characterized the business of that company. The establishing of works here means an important accession to our local manufacturing interests, which deserves every encouragement on the part of the citizens.

The harvesting of wheat costs less in California than in India. Three to four dollars a day beats six to nine cents, and always will

wherever skill can be brought to bear. The makers of what are called combined harvesting machines, described in No. 80 of "INDUSTRY," have been expanding these machines until a cut of 40 feet in width is made, and one machine will cut, thresh and clean the wheat off 100 acres in ten hours, or at the rate of ten acres an hour, and for $1.10 an acre, which far exceeds the ryots of India, with all allowance for the difference in wages. The huge 40-foot machine requires but six men to operate it, and allowing one half of these to recive $3.00 a day, and the others $2.00 a day, or a total of $15.00 per day, amounts to half a cent a bushel if there are 30 bushels to an acre, or half a cent a bushel for wages, and not more than one cent a bushel for cutting, threshing and cleaning. Only one machine of this width has been made, and we think it is not likely to be duplicated.

In the last issue of "INDUSTRY" was a note commenting upon the Act of Feb. 8th, 1895, relating to vessels impelled by machinery, deploring interference with the extensive interest in petroleum driven craft on this Coast. The U. S. Commissioner of Navigation, Hon. Eugene F. Chamberlain, points out that the Act above referred to relates exclusively to vessels on the Great Lakes, and their tributaries, and is a complete code of sailing directions to avoid collisions in these waters; also sends a copy of the Act as issued by the Treasury Department. We had been misinformed by owners of petroleum boats here that the rules of inspection and license were to be applied to such craft, which would have been a serious matter. We regret the mistake, especially as it has been our pleasure more than once to comment upon the able and liberal administration of the Bureau of Navigation, under Commissioner Chamberlain, who so far as the statute permits will not be likely to add to the onerous restrictions that now apply to water transportation on the navigable waters of this country.

The electric generating plant for the Mission Street line has been completed at the Union Iron Works, and we believe is superior to any other in this City. The workmanship, design, and indeed every part will compare with or exceed anything produced in this country or elsewhere. It does one good, now and then, to stand in front of an engine of 1,200 horse power, and scan the whole without finding a corner on which to hang a criticism. The engines can be described as vertical, inverted, surface condensing, direct acting

triple expansion, with cylinders 20, 30, and 44 inches diameter, 30 inches stroke, to run at 150 revolutions per minute. The electric elements, except the field frames, shaft and pillow blocks, were furnished by the Siemens & Halske Electric Company, with whom, as many of our readers are aware, the Union Iron Works have formed a commercial alliance, and this first extensive plant under this arrangement forebodes a future of success.

Besides the large engines above noted, we found in the Union Iron Works a lighting plant for the Occidental Hotel in this City, constructed on the same lines. The electric details by the Siemens & Halske Company are a luxury to look at. The fitting and finish of both engine and all parts is perfect, and there will be a good chance of comparison when this plant is started. A most notable thing in the works is an immense hoisting plant for the Anaconda mine in Montana, the largest ever constructed on this Coast. There are right and left compound beam engines, cylinders 26 and 46 inches diameter with a stroke of 6 feet. The engines will be 23 feet high from the floor, and occupy a space of 31 $\times$ 37 feet on the foundations. The main valves will be of the Corliss type. The estimated weight of these engines is 569,000 pounds, or about 285 tons. The reels are 16.5 feet in diameter, and receive 3,600 feet of flat rope.

There is now going on between Messrs. Rix and Hunt, of this City, an interesting discussion, respecting the economy of power transmission by air and electricity, and Mr. Rix has logically concluded and proposed, that each contestant confine himself to his own branch, and presents a definite case, normal in nature, to be dealt with on the two systems. The two methods are not directly comparable in this case however, that of transmitting about 400 horse power four miles to operate a mine. The electric current will be confined to rotative motion, and must be translated to some extent into air pressure for drilling and ventilation, while the air system will have to be in part converted to electricity for lighting. The fact is electric transmission caught the world napping, and now people are waking up to the possibilities of other mediums. It is only a few years ago when no one would admit an efficiency of more than 50 per cent. for air transmission. There are various qualifying conditions, such as distance, intensity, mode of application, losses, danger and others.

Mr. G. W. Dickie, manager of the Union Iron Works, did a graceful thing last month in giving a garden party at San Mateo, to the people in charge of various departments of the works. The day was occupied by drives to various places of interest, a collation served in a huge tent in Mr. Dickie's grounds, and speeches by several of the officers. Mr. H. T. Scott, president of the company, and I. M. Scott, the general manager, attended and participated in the proceedings. Meetings of this kind are by far too infrequent in this country. They lead to good feeling, zeal, and what the French call *esprit de corps*. The Union Iron Works have reason to congratulate themselves in having carried through the last two years a vast establishment, on which depended a large number of trained people, a thousand or more, that we hope will all be needed in the near future. The government contracts executed at these works have forced their extension to a capacity and size, that in times like these render the management a matter of great responsibility, and an "outing" means satisfaction with the results.

The "Valley Railway," which by the way is a good name, and long enough, would like to have their construction locomotives made here, but cannot, and for reasons that are not clear to most people. This manufacture is one on which has been concentrated for sixty years past the combined skill of the whole world, coöperatively carried out, and it has become a purely economic problem. There is not a corner on which to hang local invention, or improvement. It is a race of material and tools; not only this, there is the farther and greater impediment of organized manufacture, enabled by producing a large number of locomotives continually, and no one at all skilled in such matters will wonder that the Valley engines cannot be made here. This does not mean that nothing else can be made. It is an exception, and a marked one.

Major Pearce, of St. Louis, a manufacturer there, who has been around the world to see how things are done, lectured before the San Francisco Chamber of Commerce last month, to explain how the Malay and Mongolian races would soon steal away our arts and manufactures, and thus ruin a vast industrial population in this country, "depending on the manufacturers for support." This is hard on the "dependents," and very kind in Major Pearce to begin

planning some kind of means for their relief. The other elements of manufacture, such as capital, can take care of themselves. We have carefully examined the remarks of the Major, and find no difficulty in placing him among those who want to build a wall around this country, as soon as the Chinese one is down. The decadence of Great Britain, the annexation of Hawaii, and his concern for the dear working people, all point to a system of belief that render his predictions harmless. He thinks that a ship can be built in Japan at 30 cents a day for workmen, which is true, but the ship would cost more than if built here at $3.00 a day, and as soon as the efficiency of the Japanese workmen increases, their wages will rise in like proportion. We venture the suggestion that Major Pearce move his factory to Japan, and let the American workmen shift for themselves, without his patronage.

The following letter has been received :

To the Editor of "Industry," *Sir:*—Noticing your advocacy of the cause of the steam turbine, I wish to state that a San Franciscan, Robert Hewson, has invented and put to practical use a steam turbine identical in principal to the de Laval. The reason the de Laval turbine has not been introduced in this country is because it conflicts with Hewson's patents. Hewson was the first man to apply a steam turbine to marine propulsion, he having had two launches running successfully on the bay, several years ago.

To this we will say that "Industry" has always presented and promoted local inventions and skill, but in the case of Mr. Hewson's engine has never understood that it worked expansively, or utilized expansion, consequently could not claim a place with the carefully worked out engines of Parsons and de Laval. If Mr. Hewson's invention includes the methods of the latter he has in his hands a valuable property. The whole theory of the modern steam impulse engine hinges on this matter of expansion, otherwise the method goes back to the time of Hero, twenty-three centuries ago. Dr. de Laval's patents in this country, which we examined some time ago, certainly include his method for utilizing expansion, his only discovery worth considering in connection with impulse engines.

We boarded an electrically propelled car recently, to note the action of the brakes, which is the main cause of the numerous accidents that are happening in all parts of the country. One or two

stops made all clear, in so far as that car, which is no doubt typical of all. The lack of brake control is inherent in the system as now carried out. The armature is a fly wheel, and there is no possibility of promptly stopping the car when the armatures are positively geared to the axles, and people will continue to be smashed, until there is provision for the attendant to disengage the armature and let that run on when the car is brought to a sudden halt. It is a question of money and maintainance, but so long as we pay double as much for riding as is demanded in other countries there are reasonable grounds for complaint. If a motorman were given power to stop a car suddenly, as they are now arranged, the armature would go on and smash things. It should be clutched by friction plates that would yield when the brakes are fully applied, the friction equalling the full torque of the armature.

COMMENTS.

Any amount of testimony before the Federal officers at this port will not much change popular opinion respecting the causes that led to the loss of the *Colima*. This calamity arose no doubt from what is sometimes called a "general looseness" in respect to discipline, rules and the requirements for safety that characterizes passenger ships elsewhere, and there is great culpability on the part of the government that meddles with almost everything else in navigation except what concerns the safety of passengers. It seems the *Colima* had on her spar deck a lot of freight and top hamper that presented a large surface to the wind, and her carried weight so stowed as to raise her center of gravity until there was, in sea terms, no metacentric stability to withstand beam seas. Her engines, either from want of power or from accident, could not keep steerage way against the storm, and she fell into the trough of the sea and capsized, and if she had not turned over her decks would have been driven in. The deck of a ship is her vulnerable part, and whenever her head cannot be kept to a storm the end has come. Twenty-five years ago the *Nautilus* with a deckload of cattle, and an empty hold, attempted to run from one port to another in the Gulf of Mexico, was caught in a storm and turned over. No passenger ship should be permitted to leave her moorings unless in proper sea trim.

A number of our contemporaries, advocates of high protective tariff, have, under the unction of some flattery by a writer in the *North American Review*, been inveigled into printing a forcible argument against their usual faith. It is a well-known fact that in this country, and perhaps in all countries, the toleration of a tax on consumption results from a belief in this policy maintaining high wages. The other school contends that wages must be lowered by dear material and expenses. The article alluded to claims that one farmhand in America produces as much grain as three in England, four in France, five in Germany and six in Austria, which is true no doubt, and if the comparison was taken with California the difference would probably have to be doubled. It naturally follows that wages can be in proportion, or even more than in proportion, in this country. Farm hands are commonly fed and lodged, or at least many of them are, and if one man will do as much as five others the product of his labor, after deducting the expense of implements, food, lodging and superintendence, should command about seven times as much wages where the product of work is five to one.

A good deal of talk, and perhaps some action, will result from an obvious infraction of what is called the alien contract labor law by people in this State, who have imported Mongolian laborers to order. We have no faith in this, or any other law of the kind, doing any good, but so long as the law exists there should be enforcement of its provisions. Our laboring population look upon it as a serious matter, and it was intended, or expected at least, they would do so, but if the unions will take the trouble to investigate they will find that the people who are making these alien contracts are the very same people who pretend to be the champions of American workmen and high wages. There will not be found, we venture to say, a single exception. There is, no doubt, little or no gain by hiring Japanese or Chinese workmen in so far as wages, but there is a great difference in what we call "steadiness." In Mendocino County recently we were informed that the Japanese were a necessity there because the native workmen were too "uncertain."

Never before have wages been advanced so rapidly and so widely as in the last two months. It is a good sign, one of fairness and the accretion of pay is by no means all added to the cost of

products. Men do more when they are treated fairly. It is, however, a sorry refutal of the "demand and supply" theory. There has been no scarcity of labor. The great army of unemployed has not been much diminished, so that demand and supply can have but little, if anything, to do with the matter. The greatest fact of all, and the most beneficient in this increase in wages will be in allaying labor disturbance and the evil influence of discontent. It gives hope of reform, indeed is reform of the commercial and social tendencies of our time. The number of cases in which wages have been increased is too great to be listed here, and extends to nearly all branches of manufacturing industry.

An American company at Birmingham, Alabama, have secured a contract for $370,000 worth of cast-iron water pipes to be furnished at Tokio, Japan, and this circumstance, with others of the kind in iron export trade, has called out a great deal of comment abroad, but there is nothing strange in the matter. The fact is that both iron and steel are now being produced here at a lower cost than anywhere else in the world, and if prices remain as they are now nothing but a want of commercial connections can hinder a great trade abroad. Birmingham, Alabama, is the place of cheapest production at this time, but the Pittsburgh works are also below European competitors in prices for many kinds of iron. The railway hauls from Birmingham to the Gulf, and carriage around Cape Horn, it seems costs more than to send the Tokio order this way, so the work will be carried to this Coast and shipped direct to Japan.

There is no doubt that the efficiency of all the various navies in the world will be impaired by the contention between the staff and the line, or as we should say, between the engineers and the line. It is like the war, but less logical, between classical and scientific education. That future naval officers will have to be engineers rather than sailors, is now becoming apparent, especially as war ships are now being more and more converted to engineering establishments, crowded with complex machinery of all kinds. Even the offensive and defensive functions are operated through machine action. The *Practical Engineer*, London, points out in a recent issue, that the total number of engineers in the British navy is 1,147, and the horse power 1,816,140, or one engineer to 1,583

horse power, and that the ships built, but not commissioned, and those now building, foot up 508,300 horse power, for which no adequate engineer force is provided. Our own navy is much the same if not worse, and there is no adequate provision to make up the deficiency.

There is to be held at Albuquerque, New Mexico, from the 16th to the 20th of September, this year, the Fourth National Meeting of the Irrigation Congress of the United States. In the call for this convention, there are the following remarks:

"It has seen a wonderful awakening of popular interest in the cause throughout the East, resulting in the organization of most potential forces for the purpose of coöperating with the Western people; the enactment of well considered irrigation laws in eight States, and the creation of administrative systems in five of them; the recognition of the pressing nature of the problem by the Departments of the Interior and of Agriculture, under whose direction a National Board of Irrigation has been formed from officials in various departments of the government.

In view of the nature of the opportunity, a programme of extraordinary variety, interest and importance will be arranged, and it is anticipated that this session of the Congress will be more widely useful and influential than the previous conventions at Salt Lake, in 1891, at Los Angeles in 1893, and at Denver in 1894. The friends of irrigation throughout the United States—for today the movement is national in its scope and interest—should unite in an effort to obtain a worthy result at Albuquerque."

The changed relation between the classical and scientific studies in our universities and colleges, especially in this country, is one of the wonders of our time. It seems only a few years ago, when the student in a classical course looked with contempt upon his brother studying the natural and physical sciences. Then came a struggle between the two systems of teaching, or of education, in which the result is now plainly before us. The classical branch is defeated in so far as constituting or embracing the elements of a modern education, it is becoming an adjunct of a higher education, but has a second place, or rather has a special place in connection with the imaginative, social and spiritual elements of life. The spirit of our time is seen in the pursuit of "facts" that can be proven and compared. The difference in these systems of education is not so much in the nature of the things taught, as in the systems of instruction, or the machinery of the schools it may be called.

U. S. Consul Claude Meeker, at Bradford, England, has stirred up quite a lot of comment by sending to the State Department some definite facts in respect to the sale of American woolen cloth in Bradford, stating that one firm there had sent out an agent to sell with the other things American cloth. The wool and cotton reporter thinks there is nothing to be gained by such trade, but that what our manufacturers want is the American market. This may be true, but the way to secure the American market is much the same as securing other markets, that is to produce cheaper than rival firms in Bradford, or anywhere else, or in other words, make it possible to sell American goods abroad, which is the same thing as making it impossible to sell foreign goods here. The shelves of our stores are piled full of imported goods of various kinds that will soon disappear when it is possible to export American goods of the same kind, so the significance of the fact above stated does not lie in the sales abroad so much as in prospective sales at home of the same goods.

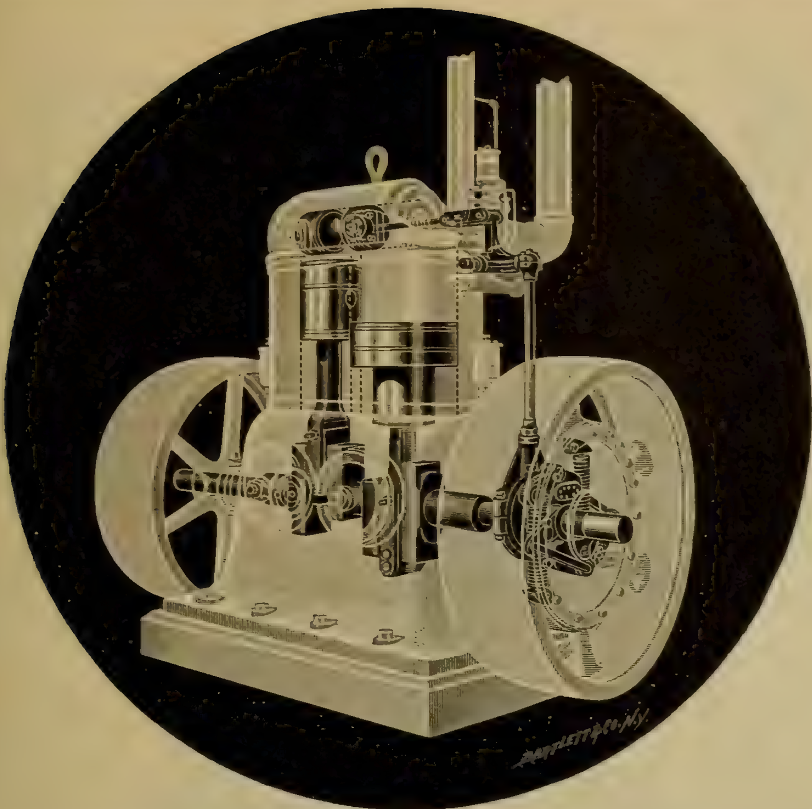
The *Oceanic*, after her last run from here to Hong Kong, sailed from that port to England to be overhauled. This vessel has been in service here for twenty years, after five years in the North Atlantic, and except one trip to England for new boilers, has never missed a journey. Twenty-five years of constant service is a wonderful record, and the ship, except her wearing elements, is nearly as good as ever. We made a journey in her on her second trip to New York, and well remember the criticisms of the time. She was the pioneer vessel of the White Star Line, and the first that had the passenger saloon amidships, also had many other innovations, introduced by Messrs. Harlan & Wolff, who built her at Belfast, in 1869. The engines which seemed to be on the same perfect plan as the hull, were made by Forrester of Liverpool, Harlan & Wolff not having at that time engine-building facilities at Belfast.

The death of Eckley B. Coxe, of Drifton, Pa., one of the founders and early presidents of the American Institute of Mining Engineers, is a great loss to the activities of that body and to the profession generally. Mr. Coxe studied in Freiberg, under Weisbach, and translated the Professor's work on mechanics into English, converting the quantities into our units, a most tedious undertaking. Most of all, however, in the kindly notices of his death that have

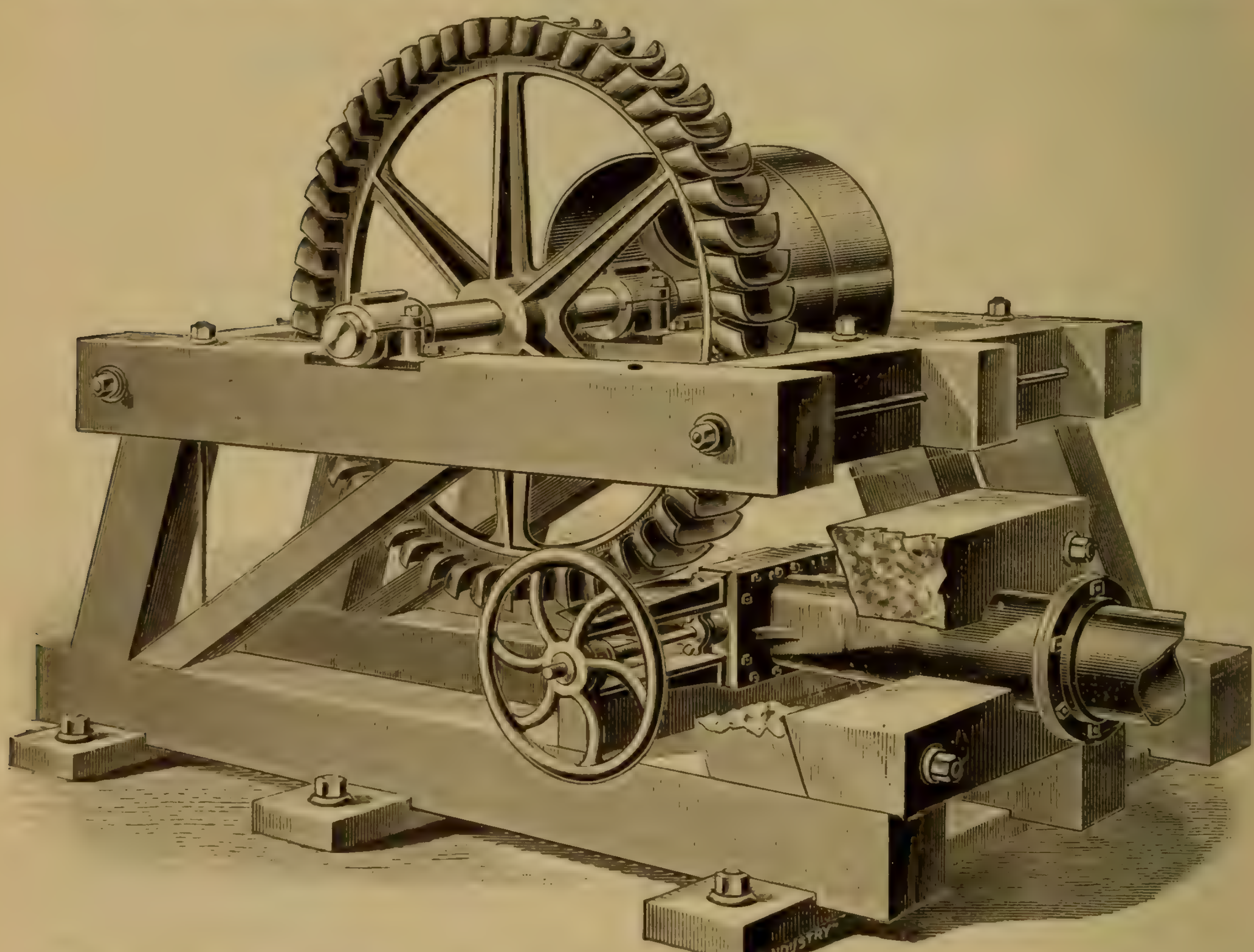
appeared, that which gives a measure of the man was his refusal to serve in the legislature of Pennsylvania because he had contributed to a campaign fund of the Democratic party, of which he was a consistent member. He was a member of both the Civil and Mechanical engineering societies, and was president of the latter during 1893. His whole life, public and private, was one to invite emulation.

English journals speak of the "improvements" made at Liverpool by bringing the trains and steamers together, or in other words, running the trains to the embarking piers. A more accurate way of describing the matter will be to say that the Liverpool arrangements are such as to permit passengers to pass through there without delay, and without parting with certain shekels that lodged there by a want of connection. It was not interest in the welfare, or convenience of the public however, that prompted this "improvement." It was the American Line at Southampton, where railway passenger trains go to and from the piers, and one may be said to begin or end a trans-Atlantic journey at London. The freeing of ports in England, using this term in its broadest sense, has been a long work, and vested rights have hung on like the Barnacle family. Bristol would have been made a great terminal port some years ago but for special "dues" there.

Drawings of the buildings at the Denver Exhibition have been published, and if followed out will far exceed in character what people are expecting, and in ordinary times, that is at any time during ten years past, would be too expensive and large, but mining interests are just now in a state of evolution, and no State in the Union can profit so much, or nearly so much, as Colorado can by an exhibition of this kind. The architectural designs are fine, and a reflex of the great Chicago display, which must for a long time to come furnish a precedent in such things. The completeness and beauty of the buildings and ornamentation at Chicago were produced by criticisms that wounded the commercial element there. The people, it was claimed, had no taste, but they had dollars to employ it, and courage to make the investment. The Denver buildings are a modest reflection of those at Chicago.



THE KNIGHT WATER WHEEL



The drawing above shows one of Knight's Standard Water Wheels, of which there are more than 450 in use in California alone. These wheels are made from 2 feet to 6 feet in diameter, from 10 to 1000 horse power, and adapted to all heads and to all purposes. Their first cost is less than one half as much as pressure turbines, and the expense of maintenance is not one fourth as much. Circulars with full description and particulars sent free.

KNIGHT & CO.

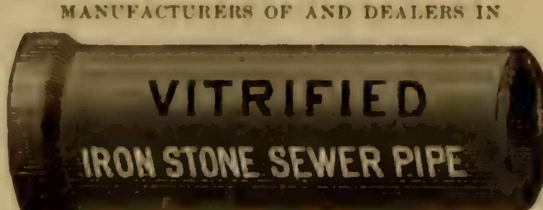
SUTTER CREEK, Amador County, Calif.

RISDON IRON WORKS, San Francisco Agents.

N. CLARK & SONS

MANUFACTURERS OF AND DEALERS IN

CAPS AND TOPS



FIRE BRICK AND FIRE CLAY

Water Pipe **Chimney Pipe**

17-19 SPEAR ST., SAN FRANCISCO

There is no one interested in the case that will not feel a tinge of national shame over the late decision in the United States Circuit Court of Appeals in the Berliner telephone case. The Berliner patent was on the 18th of December last, declared invalid by Justice Carpenter, and we venture to say that not one in ten thousand who considered the matter, questioned the fairness and legality of that decision. Now the Court of Appeals decides that this decision must be "reversed," and a new one given, no doubt reinstating the Berliner patent on the transmitter, and confirming the monopoly for a further term of years. It is a questionable proceeding, and an unfortunate one, because just at this time there is a rapid waning of confidence in court decisions, and one can hear even our highest courts spoken of contemptuously. The last decision in full had not reached here when this was written.

In these days of innovation the latest thing is "acetylene," and this is what it is for, quoted from a contemporary:

"Acetylene surpasses in lighting power and economy all other illuminants known. When burned at the rate of five cubic feet per hour it produces a light equal to 250 candles, whereas the best illuminating gas made from coal or water gas rarely exceeds twenty-five candles for each five cubic feet burned per hour. Philadelphia city gas is rated at from nineteen to twenty candles. Acetylene gas will, therefore, produce twelve and one half times more light if the same quantity be consumed, or 1,000 cubic feet of acteleyne gas will give you the equivalent in lighting power of 12,500 cubic feet of your city gas, it has therefore twelve and one half times the value. To illustrate more fully the difference, we will first pass your city gas to the tube attached to this stand, and ignite the gas as it issues from the burners, we then conduct acetylene gas to a similar row of burners, and light these, the contrast, as you will perceive, is almost marvellous."

Engineering Notes.

One of the most astonishing things in steam engineering for some time past, is the building of a triple Corliss beam engine, by Messrs. W. B. Thompson & Co., of Dundee, Scotland, for a cotton mill in Bolton, where the celebrated works of Messrs. Hicks, Hargreave & Co. are situated. We made up an analysis of the design of this engine, but had no room to insert the article this month, but will say that estimated on all points, it will be hard to

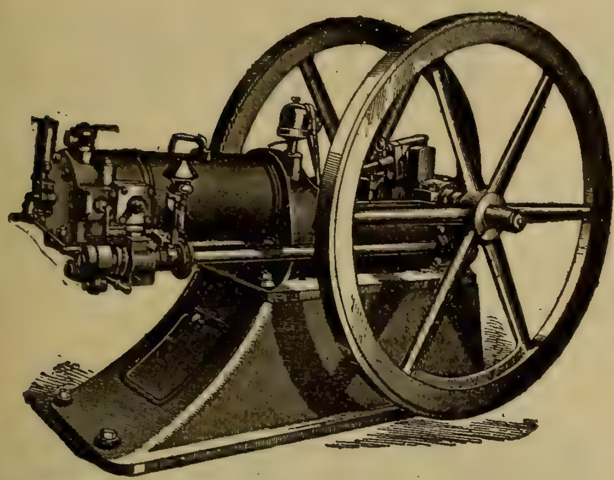
show wherein the plans are not "advanced" practice. There are three cylinders and three beams, the cylinders standing on the floor-level accessible all over. Everything is in equilibrium, the foundations light, very little detail of framing or mechanism. The efficiency is very high, the coal consumption being 13.08 pounds per horse power hour. Tests of the engine were made by Mr. Longridge, a well known and competent engineer, who awarded a premium to Messrs. Thompson & Co. for exceeding the stipulated requirements of the contract. It is not yet safe to deride the beam engine. It may come back like Hamlet's sire to disturb our modern ideas.

The British cruiser *Terrible*, now well on to completion, is what her name indicates, a "terror." This vessel, which was launched on the first of June, is 500 feet long, 70 feet beam and draught of 27 feet, and her speed is to be 20 knots an hour in service, but the trial speed is to be 22 knots. The bunkers hold 3,000 tons of coal, enough for long journeys at low speed. The armament, which indicates modern tendencies in ordnance matters, has for the heaviest pieces two guns of 9.2 inches bore; there are six of 6 inches, and twelve 3-pound guns, besides a complement of the machine kind. The hull is steel covered with wood, and sheathed on the method recommended by U. S. Chief Constructor Hichborn, and is no doubt the forerunner of other practice to follow, because fouling must be avoided in some way, otherwise a fast cruiser is a farce. The *Terrible* resembles one of the late torpedo boats, and looks more like a merchantman than a war vessel.

The twin rolling mill engines, made by Messrs. Galloway, of Manchester, England, for the Johnson Co., at Lorain, on Lake Erie, are a wonder in their proportions, some of which are as follows, for the larger of two engines: Diameter of cylinders, 55 inches; stroke, 60 inches. The piston rods are 9 inches diameter; main bearings, 22½ inches; length, 24 inches. Diameter of crank pins, 22½ inches; length, 18 inches. The valves are of the piston type, 22 inches diameter. Total weight of the engines is 347 tons. A second one, ordered at the same time, has steam cylinders 48 inches diameter, and weighs 285 tons. These weights we understand do not include fly wheels. The Johnson Company bought from Messrs. Galloway, an engine of the same kind eight years ago, and

THE OTTO GAS ENGINE WORKS

PHILADELPHIA, PA.



Power FROM GAS OR GASOLINE

Cheaper than Steam.

SIZES:—1 TO 120 HORSE POWER.

Engines built on scientific principles for high Efficiency and Economy.

H. P. GREGORY & CO., Agts

SAN FRANCISCO and LOS ANGELES.

2 Medals and 3 Diplomas at Columbian Exhibition.

PACIFIC
ROLLING MILLS CO.

MANUFACTURERS OF

RAILROAD and MERCHANT IRON

ROLLED BEAMS

Angle, Channel and T Iron.

Bridge and Machine Bolts

Lag Screws, Washers, Nuts, Ship and Boat Spikes, Boiler Rivets, Coil Chain. Harrow Teeth, Tire Rivets and Burrs, Turnbuckles.

IRON AND STEEL SHAFTING

Steamboat Shafts, Cranks, Pistons, Connecting Rods, Etc.

CAR and LOCOMOTIVE AXLES and FRAMES, and HAMMERED IRON OF EVERY DESCRIPTION.

IRON AND STEEL BRIDGE, ROOF, AND RAILROAD CAR WORK, A Specialty.

CAST STEEL CASTINGS

— AND —

STEEL FORGINGS

Up to 20,000 lbs. weight.

Gearings, Shoes, Dies, Cams, Tappets

PISTON HEADS, RAILROAD AND MACHINERY CASTINGS, OF EVERY DESCRIPTION.

— ALSO —

Homogeneous Steel

Soft and Ductile

Superior to Iron for Locomotive, Mining and Marine Forgings.

Also, Steel Rods from ¼ to 3 inch diameter, and flats from 1 to 8 inch. Angles, Tees, Channels, and other shapes; Steel Wagon, Buggy, and Truck Tires, Plow Steel Stamp Stems, Cam Shafts, Piston Rods, Machinery, and Special Shape Steel to size and lengths.

STEEL RAILS from 12 to 45 lbs. per yard.

Offices, 100 Market Street, San Francisco.

Send for Catalogues. **Highest Price Paid for Scrap Steel.**

its excellent performance led to the present orders. What there is in the design or otherwise, that caused these orders to be sent abroad we do not know. Rolling mill engines are peculiar and special, and it is probable that none of our makers were prepared for such heavy work not likely to be repeated.

There is a kind of ludicrous air about a serious article urging the advantages of pivoting line shaft bearings, and explaining the ball and socket method, in an English journal of recent issue. This method of making bearings was introduced in England nearly fifty years ago by John G. Bodmer, and the same manufacture for line shaft fittings was commenced by Tangye Bros., at Birmingham, in 1878, or thereabouts. In this country one may say there has been no other method of making such bearings since it was introduced by Messrs. William Sellers & Co., of Philadelphia, not less than thirty years ago. The object of Messrs. Sellers & Co. was to distribute the pressure over a large surface, so that hard material, that is, cast iron, could be used for the shells, a practice followed by the firm ever since, and wholly successful. No shaft runs precisely true, and most of them run decidedly untrue, so that a pivoted bearing is the only one that permits a fit.

We have several times received inquiries as to what delta metal is. It is often mentioned in marine specifications, but is not in common use here. It is simply brass with a small amount of iron that renders the alloy ductile so it may be worked when hot. Ordinary brass is made of copper and zinc in various proportions. Two parts of copper to one of zinc makes good brass, tin should be added for bearings. Muntz metal is brass, usually with some lead added. Phosphor bronze is copper, tin and phosphorous. Manganese bronze is made by mixing ferro-manganese with brass or bronze. It is as strong as wrought iron. Aluminium bronze is 97½ copper and 2½ per cent. aluminium. So on through the list copper is the base, so to speak, tempered by various other metals, the product usually taking its name from the associated metal. There are, no doubt, many new alloys yet to be discovered, but even now the number and names are so numerous as to be confusing.

One after another comes fine engravings of symmetrically-made drilling machines, especially of the radial class, and not one in six

of them that have any other function than to revolve drills or boring bars. We, by this, mean that the spindles are operated on the principle of a "flexible shaft" by reason of the back gearing being placed on some of the first movers, away from the spindle, so the greatest strains must be transmitted through a train of shafts and wheels. We have just examined one, a heavy machine, driving a boring bar that would "jump" at least five degrees if the cutting strain was released, as in boring holes. Makers of these machines should for experiment put the back gearing of an engine lathe on its countershaft overhead, and then connect to the lathe spindle by a down shaft and two pairs of bevel wheels, then they would have a counterpart of their drilling machines.

To those purchasing machine tools we will say, never buy any metal-working machine not back geared on its main spindle. The idea is not new, is universal in the case of lathes, boring machines and milling machines, but exceptional in drilling machines. Messrs. William Sellers & Co., of Philadelphia, a good many years ago quit making drilling machines back geared on their counter or transmitting shafts, and so far as we know have adhered to this. As said, it is not new, and is not even a problem. It is only common sense. On this Coast, where there is not the "division of tools" that exists in the Eastern States, drilling machines have to be employed for boring, or should be so employed, but are far too "limber" for this purpose. It is hard to provide for lateral rigidity in such machines, but there is no good reason for not providing them with what may be called "torsional rigidity."

Accounts come of a new electrolytic process for producing alkali and chlorine, at Farnsworth, England. The salt is placed in a box made of slate, about 24 × 18 × 5 inches. From the top of this frame are suspended lumps of gas-retort carbon. The frame is open at the sides, and is covered by a sheet of "mineral fibre," whatever that is, over or against these cast-iron plates which have a cavity in the centre to catch the soda solution, the top of this cavity being protected by a wire gauze cover to support the sheets of mineral fibre. Around the edge of the cast-iron plates is a rim forming a close joint against the slate frame. This vessel is filled with strong brine, and steam is admitted to the pockets in the cast-iron plates,

GERMAN LEARNED IN ONE MONTH. THE Rote Lexicon. Price 25c. THE INDUSTRIAL PUBLISHING Co., 40 California St., San Francisco.

and an electric current is sent through the vessel, causing the alkali to settle in the pockets or cavities. The chlorine is set free inside the main vessel. The alkali solution produces 56 per cent. of soda ash.

The new electrically-driven locomotive, designed by Messrs. Sprague, Duncan and Hutchinson, and built at the Baldwin Locomotive Works, in Philadelphia, is the most extensive venture of the time, being of 250 horse power. The purpose of the engine, as described in our contemporaries, is for switching and handling in yards, which is certainly incorrect if the current is to be supplied in the usual way, from overhead wires, because no yard could be equipped in this manner. There are four separate motors, wound for 800 volts at 225 revolutions per minute, or a car speed of 35 miles an hour. The current used will be 250 amperes, and an efficiency of 90 per cent. is counted on. This is quite a new thing in the Baldwin Locomotive Works, and we may expect soon to see a diffusion of electrical work in connection with various kinds of machinery, the dynamos and motors being made as integral portions of the work. This method is now applied in some departments of the Baldwin Locomotive Works.

MINING.

NOTES.

Mr. E. A. Schneider, in the *Engineering and Mining Journal*, argues in favor of chlorination, as compared with the cyanide process of extraction, and presents some very cogent reasons for this opinion. He speaks in general however, and not in respect to particular ores. The following is an extract, and contains the conclusions from his article:

"Briefly summarized, the conclusions which have been arrived at are: Under exceptionally favorable conditions, cyaniding is cheaper than chlorination, but under all circumstances it is safer to operate chlorination works. Chlorination can be successfully applied to almost any ore, while cyaniding gives satisfactory results only with a certain class of ores. Cyaniding plants located in such localities as Cripple Creek run certain risks, as the character of the ores from this region is liable to change from day to day. Apart from that,

the cyaniding process labors under the disadvantage of requiring, in most instances, an extremely skilled chemical supervision. The chemical part of the chlorination process is, on the other hand, very simple. Lastly, the recent developments in the electrolytic preparation of chlorine, open up the prospect of a great reduction in the price of this chemical. Some of the gold-producing Western States abound in coal, salt and water power, which are the essential conditions for the cheap preparation of chlorine."

Mr. T. A. Rickard, in treating upon the amalgamating processes in the *Engineering and Mining Journal*, says:

"Many of the patent amalgamating machines daily invented have as their underlying principle the idea that the more you bring the gold into frequent contact with the mercury, the more complete the amalgamation will be. The inventor usually sets out to obtain such frequency of contact by compelling the ore to pass through a bath of mercury, or else he turns the mercury into a spray, or mixes the ore and mercury violently together, or has some other scheme, of which the essential feature is, that the mercury is cut up and subdivided into particles of more or less minuteness. Such ideas would be well enough, were it not for the fact that it is much easier to cause mercury to subdivide than to re-coalesce, since of the large amount of foreign substances present in a pulverized form, there are always some which at once proceed to coat the globules of mercury, preventing their reunion and rendering them easy of transport by water. A simple instance can be cited in the case of the amalgamating barrels used in many mills for the treatment of blanketings, pan tailings, skimmings, etc. It is usual to add pieces of iron, such as old bolts, fragments of shoes and dies, etc., in order to promote a grinding action. Very often the speed of the barrel is too rapid, or the quantity of scrap iron is too great, and if you take a pan and wash a few handfuls of the waste ejected from the barrel you will find a large amount of floured mercury."

Mr. Rickard has also some very sensible remarks on "flouring," which he says is commonly used as a synonomous term with "sickening" of mercury, but is not the same, because flouring is a subdivision of the globules, and sickening is a coating of these subdivided particles with a repellant such as grease, or talcose clay. He further claims that flouring is not an obstacle to the selective or amalgamating action of mercury, as it certainly should not be in the case of finely divided gold. He also relates a case in Ballarat, Australia, where the condenser water was run over the plates, and performed well, although the water contained oil, but it was afterwards

discovered that the foreman used five pounds of quick lime in each battery daily, and this lime of course neutralized, or turned to soap any grease that came from the condenser.

It is reported that a commission of skilled men has been sent out by the Government at Washington, to examine the "economic geology" of Alaska, and especially to investigate the mineral resources of that country. The commission is composed of Prof. G. F. Becker, Prof. Wm. H. Dall, and Mr. Perrington of the U. S. Geological Survey. Their instructions of course relate to certain districts, because the observations of three men in one season, would not go far in determining the minerals of a vast territory, such as Alaska, or even that portion of it accessible and known as mining territory. The first work will be done about Sitka, Cook's Inlet and the Islands. Such a commission will result in a compilation of old information, and be useful, but in so far as new light on the subject, prospecting by miners is a more reliable kind of investigation, or is a more complete kind at least.

Out of the Yukon region in Alaska came in 1894 less than $250,000, and it no doubt cost more than this, which may not mean that future operations will be the same. The natural obstacles are great. The *Mining Industry*, Denver, speaking of placer workings, says:

"In many districts the gold-bearing rock is twenty or more feet below the surface, and shafts must be sunk to that depth through ground frozen solid, and by a most laborious process. The prospect holes are usually about 3½ feet wide by 6 feet long. Enough wood must be cut to cover this space, and a rousing fire be kept up for almost a whole day before the ground is sufficiently thawed for the miner to get out a foot or a foot and a half of gravel and soil. One man can burn a hole down about a foot a day. The work can be done only when all the surface water is frozen, otherwise it would drain into the prospect hole. In this region wells have been sunk seventy-five feet or more, all through frozen ground, and the miners say they never got below the frost line."

Mr. C. L. Hall, writing to the *Mining Review*, Denver, thus graphically describes the Box Cañon, at Ouray, Colorado:

"In blasting along the cliff, that walls in Cañon creek, less than a mile from town, to make way for a pipe line being put down by

Charles H. Nix, to convey water to his electric plant for lighting the city, a marvelous cañon has been disclosed, never before penetrated by the footsteps of man. It was impossible to explore it until this excavation was made, and a foothold obtained in the vertical cliff.

For countless ages the waters have been surging and seething between these mural abutments until by abrasion and erosion the bed of the stream is worn down hundreds of feet into the solid limestone, porphyry and trachyte. The walls in places are carved by the action of water into many unique and fantastic features, and polished like Parian marble.

It is one of the most weird and awe-inspiring natural amphitheatres ever seen in primitive nature. In the defile are deep and narrow gorges, overhanging rocks, vertical falls of hundreds of feet, bottomless pools, where the waters boil and eddy, and gather power for additional leaps and plunges in their wild flight through the grand and awful cañon. There are places where the sun's rays never penetrate, and the very light of day seems to creep in with fear and trembling."

The Commissioner of Mines has been appointed in Colorado, which one of the newspapers at Denver says, is a "worthy recognition of long service to the Republican party." This sounds ominous for a new Bureau. The bill creating this Department, was draughted at request, by Mr. W. C. Wynkoop, editor of the *Mining Industry*, and others competent to prepare such an Act, in which there was provision for a board of trustees, who should appoint a Commissioner of Mines, and otherwise manage the Bureau, thus removing the matter from politics, but this clause was dropped out, and the result will be as indicated above, another political attachment to the State's industrial affairs. Considering the extent and importance of the mining interests of Colorado, which may be called paramount, it is a dangerous thing at this day to permit political interference of any kind with officers who are to exercise only technical functions.

It is common to say that a stamp mill will crush a ton of ore in a day. It is a convenient and handy rule, but is not correct. In South Africa the rate is nearly four tons a day to each stamp. The Colorado ores are crushed at the rate of one ton a day for each stamp, and in California the average is about double this. A good deal depends on the kind of machinery employed; not that the efficiency is in proportion to the weight or size of the machinery, because a stamp can be made to crush more or less, so the true measures are horse power, wear and attendance. In the Lake

Superior copper mines one stamp such as they employ there will crush as much as twenty gold stamps, so that between hard and soft ores, fine and coarse crushing, and the weight or power of stamps, the "ton a day" rule is a very indefinite one.

The Boer Government in South Africa is by accounts preparing themselves for what people sometimes call a British outrage. The English people have an enormous investment at and around Johannesburg, which may be estimated by considering that there are 3,200 stamps at work, about as many as there are in the whole of this State, producing thirty to forty millions worth of gold each year. The little Republic, where these mines are situated, was a seven by nine affair, with an emasculated treasury. Now it is a great government in so far as authority, with five millions of a surplus, and a code that taxes everything, denies suffrage to all but natives, and even forbids public meetings in the open, or private meetings of more than five persons. The Boer Government will go a little too far no doubt, and have no sympathy if called to account by the British Government.

People commonly think of the South African mines at Johannesburg as being on an arid plain at sea level or near it. One naturally associates such an idea with the scarcity of water there, but the "reef" is between 5,000 and 6,000 feet above the sea. The deposit is conglomerate, standing at an angle of thirty-five degrees or so, formerly, as supposed, the floor of a great basin, but upheaved by some vast convulsion of nature into its present position. The life of this African Comstock lode is estimated at from twelve to fifteen years, and the fabulous production, it must be remembered, is due to appliances and a cost commensurate with the output. When the whole matter is done with, supposing this to occur as above stated, the entire product divided by investment and losses by stock jobbing will show the inevitable result, that to procure a dollar's worth of the gold costs one hundred cents.

We have argued for years past that the price of gold or anything else depends on the cost of its production, measured in terms of labor, risk and money investment. It is a law of economics. Supply is a sequence. One mine may produce a dollar's worth of gold at four cents, as the Independence Mine at Cripple Creek, Col., is

now reported to be doing, but it is an accident, and to balance this is the long list of "non-dividend" and abandoned mines, all chargable to the general account of gold production. Fluctuations or temporary changes in the prices of commodities are regulated by demand and supply, but original value or natural prices are as the cost of production. Gold and silver will rise and fall by this rule, and no other.

Mr. Thomas Pilkington, of this City, who has had a wide experience in mining matters, has recently procured patents in the United States on an improved amalgamating apparatus that seems to embody a good many very practical and useful features. It consists of a short rotary cylinder or barrel that can be set close in front of the stamp batteries, and instantly rolled out of its seat for cleaning, another barrel being substituted. The barrels contain a series of baffling vanes, easily removed from the outside, and so placed as to direct the pulp outward against the interior of the barrel, instead of to the center in the usual way. The main barrel is open at both ends, the interior all the time in view, and the whole arrangement one of exteme simplicity, providing in a small space a large area of surface that can be readily handled and continually inspected. In the treatment of the pulp, or in the method of agitation, every particle comes in contact with the mercury and plates, and is continually changed, so the selective action is rapid and complete. Mr. Pilkington's present address is at Vallejo, Cal.

The Napa Consolidated Quicksilver Mining Company have declared dividend No. 68, payable July 1st next, of $20,000. The gross earnings of the mines are about $17,000 a month, and the shareholders are to be congratulated on having a permanent and profitable property. The quicksilver interest seems to have centered around Mount St. Helena with notable extension since the closing of the New Almaden mines four or five years ago. The product now for the whole country is but little more than $1,000,000 a year. The Spanish mines produce something more, and the total of all countries continues much the same as ten years ago, but the consumption is much increasing on this Coast, and a rise in prices can be safely predicted. The Lake County region, if it be reached by railway, would soon become a center of quicksilver mining, but as

now the hauling is a great impediment. At the Great Western and Mirabel Mines the "teams" seem to be the most prominent part of the establishments.

Mr. D. T. Hughes, of Sausalito, has for some time been prospecting the grounds of Tillwooet, Fraser River, and Cariboo Gold Fields Company, in British Columbia, an English corporation, of which F. S. Barnard, a member of Parliament, is chairman. Mr. Hughes, who is a skilled mining engineer, has been for some time past sinking shafts and testing the placer grounds and gravel on the claims, and now reports an unexpected richness of the material over large areas. The Company have appointed Mr. Hughes mining superintendent, and no better selection could be made; he is a conservative man with a wide experience, a solid miner, so to speak, and we trust will make a complete success with the company's property.

Miscellaneous Notes.

The *Engineer*, New York, published some time ago an engraving of the old steamer *Beaver*, built in England in 1835 for the Hudson Bay Company, and the first steam-propelled vessel to perform duty on this Coast. The engines were made by Boulton & Watt, of the side-lever type, two cylinders of 36 inches bore, and like stroke. The steam pressure was five pounds per inch, and this was a convenience in stopping leaks in the boiler, which the narrator, Mr. Lacy of this City, says was of frequent occurrence. This old steamer, like the *City of New York*, "got piled up on the rocks" somewhere in the Sound, where her old copper-fastened frame of oak lies visible at this day. The name *Beaver* was appropriate. It was this singular animal, now nearly extinct, that gave the company their principal revenue. The main lesson afforded now by this old relic is the good workmanship and material that has lasted fifty-eight years.

It is significant to see in the *Railway Review* an engraving of what is termed a "handsome bridge," which it really is, of the most plain and simple design that has appeared since the Roman aqueducts were built. It is a railway bridge of masonry in France, of seven elliptical arches, the spandrils of each pierced with three cir-

cular top arches; in fact the whole style reminds one of the great aqueduct at Rome. The course of taste, like all other things human, is a subject of evolution, from the tawdry colors and fantastic decoration of the savage to a refined sense of natural grace and fitness born of culture and intelligence. Struggling in the race does not seem to do much good. Architects have for centuries strived to arrive at some standard of perfection, and thereby have only achieved "fashion" if one is to judge from the diversity of their designs. But then we cannot build a whole street of contiguous houses all alike. Railway bridges can, however, be uniform.

There has been apprehension expressed that the tin plate business was being overdone, on the basis of production and consumption, and if there is anything near a balance between the two, tin shares are a good thing to avoid, because the consumption of tin will no doubt fall off in future, relatively if not absolutely. There are many substitutes coming into use, so much so that the U. S. Consul, in Belgium, reports that he does not find in his home a single utensil of tin. Boxes are now made of wood and paper, and for roofing and other building purposes enameled and zinc coated iron and steel is fast taking the place of tin, which is a dear metal, and of more value in other uses than for weather coverings. A principal use that seems to hold its own, in this country at least, is in packing fruit and other food, but at any time this may change, indeed there is a good deal of opposition now to tin packages, on the grounds of danger from poisoning, in the case of acid fruits.

Mr. John Birkenbine, president of the Engineers' Club in Philadelphia, in an address before that body some time since gave some facts in respect to the draining of the valley in which the capital of Mexico is situated, and incidentally mentions the rate of wages paid there. The rate varies greatly, one authority places the average for unskilled labor at 27 cents a day for the whole country, which if it means Mexican centavos is only one half as much in these coins. The highest rates the speaker found in Mexico were in the machine shops in the City of Mexico and Puebla, where 6 reals or 75 centavos were paid. The "centavo" is nearly equivalent to one cent in nominal value. Skilled men are much better paid, the highest wages being from $1.50 to $4.00 a day in

Mexican coin, or as we may say, 75 cents to $2.00 in our currency. As, however, skilled labor is exceptional, and consequently the rate far higher in proportion, the average including all trades does not reach 50 cents a day in our money.

The petroleum product of California is roughly estimated at half a million of barrels annually, worth one million of dollars. The industry was commenced from 1851 to 1856 in a small way, and then went through the inevitable "boom." In 1865 there were sixty-four petroleum companies with a "nominal" capital of $45,000,000. The principal source now is the Pico Cañon in the San Fernando Mountains, Los Angeles County, but petroleum is found at many places all over the State. At several springs around Mt. Tamalpais, near San Francisco, petroleum is given off in small quantities, but the volcanic nature of this Coast precludes any great or regular deposit such as exists in the vast beds of Pennsylvania, or around the Caspian Sea. It seems in California that whatever minerals are found in vertical veins are successfully mined, and those that should occur in horizontal strata are not so successful, or at least not so permanent.

Wyoming can claim the greatest coal seam, 80 feet thick of clean mineral. Another item of 4,000 acres, under which there are 300 feet of coal. Professor Lakes in the *Colliery Engineer* says, these vast deposits are of fine coal, containing 42 per cent. volatile matter, and 47 per cent. of fixed carbon, with 2 per cent. of ash. At New Castle, Colorado, are coal veins 40 feet thick, also at Durango, in the same State, are veins superimposed, that make up 80 feet in thickness. Rocky Mountain coal is to this time not a great factor in the industrial affairs of this country, but will be so some time. New countries do not need coal like older ones, not even as their population compares, in fact the consumption of coal seems to follow the density of the population, or else density of population is produced by coal-using industries.

The fund that quackery draws from human earnings must equal or exceed the whole cost of education in this country, which seems to be its especial home and harvest. The daily press is to a great extent maintained by shameless advertisements of nostrums and

portraits of idiotic people, who for money, or by ignorance, permit the use of their names and faces, yet we talk of a common-sense age, and of a past period of superstition and darkness. Dr. Geo. F. Shrady writes of this matter, in the Forum, complaining of dispensaries and other public means of treating disease whereby the physicians fees are diminished. The whole system is an anomaly, except in China and in Sweden. If a person is ill they are not in these countries fined for being so. The physician is raised to the dignity of a national functionary, not depending on fees extracted from patients. The well people pay the physicians fees, and the ill go free.

Good coal is mined in Alabama at 60 cents a ton, and carried to tide water for 90 cents a ton, and is placed on shipboard at a total cost not exceeding $1.60 per ton. If the coal supply is sufficient there is no reason why this should not lead to an enormous trade in the near future. There is no other supply that can compete with this in the South American countries and elsewhere, within a commercial radius wide enough to consume millions of tons each year. Alabama, Georgia and Tennessee, from being backward and non-progressive, bid fair to be the central districts of Southern enterprise. Iron and coal are talismanic in the production of wealth, money follows them at this day, and Alabama can claim a place in both these interests that will soon reinstate Mobile in the position this city once held among American ports. Since the war, Mobile came near extinction, grass grew in the streets, and the only merchandise seen on the wharves was pitch pine. Now matters are different.

No. 85. AUGUST, 1895. Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor Founded 1888. W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

WASHBURN & MOEN M'F'G. CO.

WORKS:

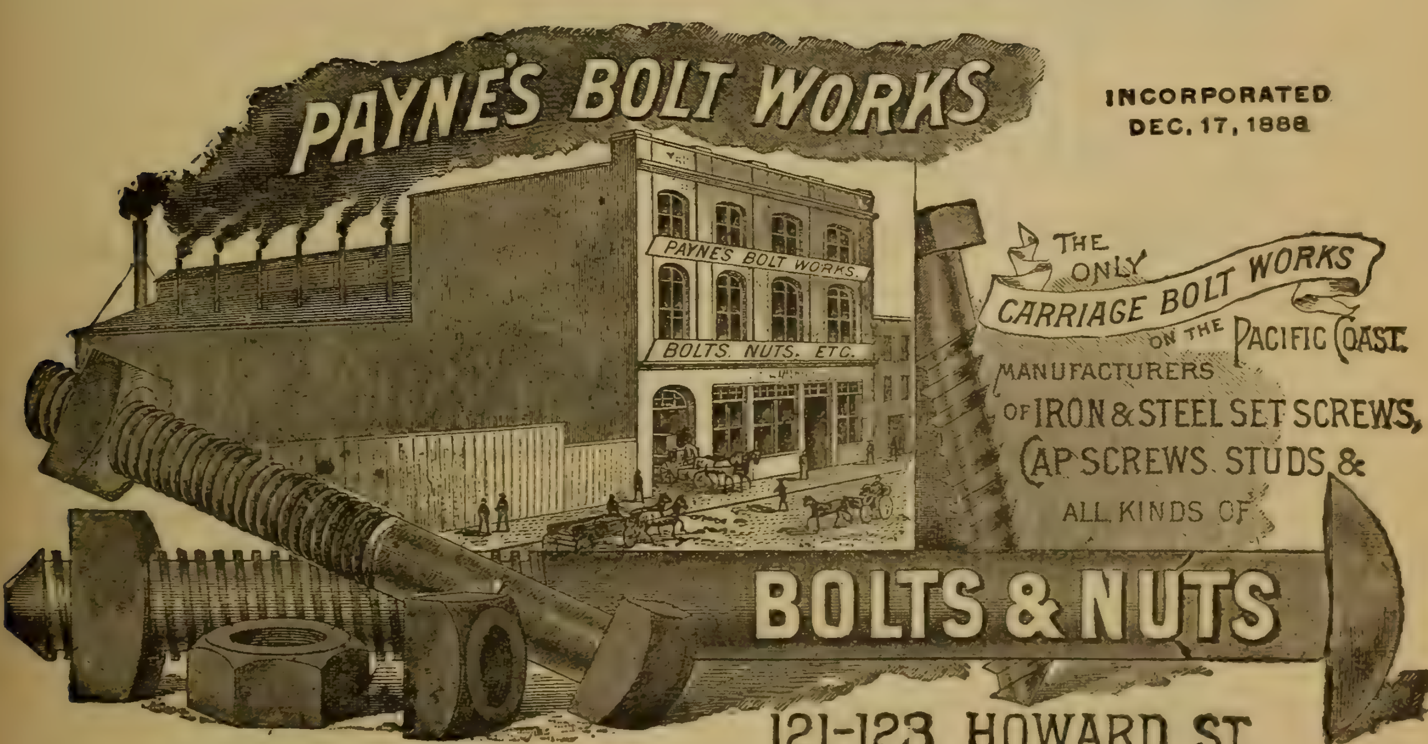
WORCESTER, MASS. **WAUKEGAN, ILL.**

BARBED WIRE.
BALE TIES.
WIRE ROPE.

IRON AND COPPER
BARE AND INSULATED
ELECTRICAL WIRES.
WIRE SPRINGS.

SAN FRANCISCO
OFFICE AND WAREHOUSE: **8 and 10 Pine Street.**

FRANK L. BROWN, Pacific Coast Agent.



Upset Bridge Rods, Truss Rods and Anchors, Turnbuckles, Head and Point Drift Bolts, Wine Cask Bolts with Brass Acorn Nuts, Cold Punched Square and Hexagon Nuts.

All Kinds of General and Special Blacksmithing

Architectural Drawing

Architecture, Mechanics, Mechanical Drawing, Electricity, Masonry, Carpentry and Joinery, Ornamental and Structural Iron Work, Steam Engineering (Stationary, Locomotive or Marine), Railroad Engineering, Bridge Engineering, Municipal Engineering, Plumbing and Heating, Coal and Metal Mining, Prospecting, and the English Branches.

The courses commence with addition in Arithmetic, so that to enroll it is only necessary to know how to read and write. A Scholarship entitles the holder to tuition until he is qualified to receive the diploma, no matter how long it may take, nor how often it may be necessary to review. Students can interrupt their studies, and change their residences. Scholarships are not forfeited upon failure to pay installments promptly. Each student is a class by himself, and has the advantage of individual direction by a competent instructor. Students make rapid progress in learning to draw and letter. Specially prepared Instruction and Question Papers, Condensed, Simplified. Architecture offers splendid opportunities to women ambitious to become self-supporting. All representations may be relied upon. Send for Free Circular, stating the subject you wish to study, to

The International Correspondence Schools, Scranton, Pa.

TAUGHT BY MAIL THOROUGH PRACTICAL

TRADE MARK REGISTERED.

FRANCIS SMITH & CO.

SHEET IRON & STEEL PIPE

130 BEALE STREET, SAN FRANCISCO

☞ Iron cut, punched and formed, for making pipe on ground where required. All kinds of Tools for making Pipe. Estimates given when required. Are prepared for coating all sizes of pipes with a composition of asphaltum.

MEDAL—WORLD'S COLUMBIAN EXPOSITION—1893.

JESSOP'S STEEL

BEST

ENGLISH TOOL STEEL

FOR TOOLS, DRILLS, DIES, etc.

JESSOP'S STEEL

ALL KINDS IN STOCK

WM. JESSOP & SONS, Limited. Works: Sheffield, England

W. F. WAGNER, Manager, Chief American Office, 91 JOHN ST., N. Y.

I. WILLARD BEAM

SOLE AGENT FOR PACIFIC COAST

29 Main Street, San Francisco, Cal.

JESSOP'S STEEL

REMOVAL NOTICE

REED & CLEVE

Pattern and Model Makers

Have Removed from 225 First Street to the Second Story of the Electrical Engineering Co's New Building, 36 MAIN STREET, bet. Market and Mission.

Machine Patterns a Specialty. Good Work. Prices up to Date.

WORKING MODELS—Wood or Metal.

36 MAIN STREET, SAN FRANCISCO

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. AUGUST, 1895. NO. 85

THE REMOVAL OF PROFESSOR DAVIDSON.

There are but a few people, even among the technical professions, in this country who will understand the true significance of the discharge of Prof. George Davidson from the United States Coast and Geodetic Survey Office, after fifty years of faithful and highly useful service. Those who would understand it have but to remember that within a year there was a proposal to place this Bureau under the Geological Survey. The present ungrateful and even scandalous act is, we believe, but one movement in a plan of converting the Coast and Geodetic Bureau into a quasi-political and consequently an exigency bureau of the Government.

The Coast Survey, established by Jefferson in 1806 and reorganized in 1842, has been the bright particular star of American scientific work, honored and admired all over the world, and now the basis of charts for the American Coasts, used by all nations, and not only the base of hydrographic determinations, but also the base for inland surveys used by the Geological Survey in such maps as have been prepared by that Bureau, a fact that none of their reports acknowledge, or even mention.

It has been our unhappiness on a good many occasions, as our readers will remember, to criticise the work and acts of the Geological Survey, a Bureau instituted by Congress to deal with the "public

domain'' alone, the only lands over which Congress has authority. The widening of the functions of this Bureau by a technicality in an Appropriation Act so as to cover the whole of the United States, and even to send commissions abroad, has been described in the *Engineering and Mining Journal*, and heretofore noticed in "INDUSTRY." The attempt by certain officers of the Geological Survey to secure a State appropriation for preparing a set of plane-table maps of California, and the circumstances of securing in several States such appropriations, is a matter of history, but we forbear to go farther into this matter. It is one deserving investigation on the part of Congress, and also by the various scientific associations in this country. Why does not the National Academy of Sciences protest? Professor Davidson has been a member of this scientific body for twenty-five years.

There is a parallel to this attack on the Coast and Geodetic Survey in the transfer of the Weather Bureau from the Army Signal Corps to the Agricultural Department. What has agriculture to do with meteorology? We presume it is on the assumption that the weather affects the crops, and the Bureau is to make the weather. It was a most extraordinary procedure, the object of which seemed to be the creation of more civil offices and more places. Our readers will remember the double removal of Lieut. Finley from this post, and the history of the matter since this combination of agriculture and meteorology. It would be equally consistent to combine agriculture and geodesy!

The next attack on these scientific services will, no doubt, reach the Engineer Corps of the army. In fact it would be more consistent in so far as rivers and harbors than in the case of the Weather Bureau and the Coast and Geodetic Survey, and as we have no department of public works, the hydrographic work of the Engineer Corps might also be added to the Department of Agriculture! If not relegated to the Geological Survey.

Colonel George H. Mendell has drawn warrants here, as we believe, to the amount of nearly twenty millions of dollars, and no one thinks, or has ever charged, that one dollar of this money was spent except for value returned, or that one dime has been diverted from its purpose for personal reasons or to favor any one. This money has been paid principally for the improvement of rivers and harbors of the Pacific Coast, and we predict some way will be found before long to confine the duties of the Engineer Corps to fortifications. While men like Ferdinand Hassler, A. D. Bache, Gen. Casey, Colonel Mendell, and Professor Davidson are engrossed in a faithful

disharge of their duties, adding luster to a national service that in other departments, by contrast, causes deep concern to every true American citizen, their mouths sealed by a sense of duty and the amenities of their profession, there is evidence of a design and plot to get rid of these "scientific fellers" who have the audacity to rise above parties, politics and persons, and thus earn the commendation and confidence of their own and other countries.

We are writing feelingly of this matter, not by reason of a deep personal regard, and the prized friendship of Prof. Davidson. He does not need or ask for any one's sympathy; so much of his life as has not been spent in an ungrateful service will no doubt find more honored and remunerative recognition in a new field.

The people of this Coast will not likely forget the services of Prof. Davidson as the General Government has done, and a fitting act would be to provide for him some position where his work may yet add luster to a State that has never forgotten those who in the hour of need labored to work out its prosperity and good name. His monuments are now built, and should bear his name in future, as they no doubt will in so far as the people of the Pacific Coast, but what are we to think of disposing of a public officer in this manner after a service through double the period that would in other countries have met with honorable recognition, promotion and a retiring pension? We may manage in this manner to sustain some kind of a national service, but if so it will be a controversion of history, of common justice, and of all analogies that can be drawn from past as well as present circumstances.

THE FULTON ENGINEERING AND SHIPBUILDING CO.

SAN FRANCISCO.

Through the courtesy of President James Spiers, of the Fulton Engineering and Shipbuilding Company, we recently visited the works at Harbor View, on the northern side of the City, and were much astonished at the changes and additions there made during two years past. The works are full of men and business in the engineering department on a variety of work, principally steam and pneumatic plants, including the now almost finished high-pressure compressing engines for the pneumatic guns at Fort Point.

Some novel boilers of 200 horse power each are being made for the Borax-Refining Company at Alameda Point. The main shells,

72 inches $\times$ 16 feet, are connected by circulating tubes with cross drums below the combustion chamber, and these again with a series of pipes closely set, that form the furnace sides instead of walls. It is a curious scheme that converts all surfaces exposed to the fire into evaporating area. The design was furnished by the engineer of the borax works.

The equipment of heavy machine tools, provided for these works three years ago, is now almost for the first time fully employed, and their judicious selection proved by a complete adaptability to the size and varied character of the work now in hand.

The crane equipment is especially complete, covering all areas where handling is to be done, and a system of railway connects all departments of the works, saving not only expense but the danger that attends on all kinds of "handspike" apparatus. The crane machinery is soon to be electrically driven.

There has been added a commodious wharf with half an acre of clear space, and provided with lifting tackle overhanging vessels that lie at the side. The area of the company's lands has been much extended in a natural way, saving thousands of yards of expensive filling. The hydrographic situation is such that a barrier or breakwater built out into the channel causes rapid filling with sand on the oceanward side. A width of 150 feet has been reclaimed in this manner within two years, and 200 feet more remains to be built in the same manner by the sea, so the ocean front, 1,000 feet long, will soon be 350 feet beyond the works and original shore line.

Most remarkable about the works is the extension of the shipyard department. Besides repair work going on for ocean and river vessels, a neat little steamer of 100 horse power with two trailing barges is just completed for some port in South America. A small express steamer to run between Rio Vista and Sacramento is being laid down, and we trust will be a complete departure from the common river type of boats. It is a double-screw, triple-expansion high-speed boat for passengers and express service along the Sacramento River. A saw mill, molding loft and other plant pertaining to this department have been recently added. Mr. John Dickie is the constructor in charge.

THE PNEUMATIC GUN PLANT.

This strange battery is being erected about a mile oceanward from the Fulton Works, and is now approaching completion. We

were shown over it by Mr. Spiers, his company being the contractors for the steam power, air compressing, pumping and other work, except the batteries, included in the Dynamite Gun Company's contract with the Government.

We are not aware of the nature and arrangement of air compressing plants for like purpose made for the company at the East, where some batteries of the kind have been erected, but we imagine the present one to be very much more complete. In this term we include the arrangement, workmanship and convenience of manipulation.

There is a battery of four steam boilers, aggregating 700 horse power, and three compounded compressing engines working by three stages up to a pressure of 2,000 pounds per inch, at which high pressure a reserve is accumulated so as to save space and expense. The working charge or pressure is reduced to 1,000 pounds per inch at the guns, of which there are three, 50 feet long, 15 inches bore.

The engine or compressing room is a model of symmetrical arrangement. The steam pipes come down through collars on the ceiling, and look like supporting columns, all the steam pipe combinations and distributing apparatus being on or accessible from the floor above. The intercooling pipes between the compressing engines are placed in cemented pits beneath the floor, so as to be flooded with water, and covered over, so the whole engine room is clear, except two water heaters set at the wall.

The distributing valves are in a separate room alongside the engineer's office, at the end of the engine room, making up a most convenient and symmetrical disposal of the whole, highly creditable to the Fulton Company and their pneumatic engineer, Mr. E. A. Rix, of this City.

This dealing with air at a pressure of 133 atmospheres is a matter not to be lightly considered or gone into, and if the machinery performs successfully, of which there is not the least doubt, it will be a most creditable work, and an evidence of capability here in pneumatic practice that is but natural, however, considering the novel and extensive applications on this Coast.

We are indebted to Mr. B. C. Batcheller, the supervising engineer representing the Dynamite Gun Company, for explanation of the guns, controlling valves and other apparatus, too complicated for description here. The nature, objects and capacity of these guns for defense was explained in an article by Mr. E. A. Rix, in "INDUSTRY," No. 79, for February, 1895.

THE LA GRANGE DAM.

ON THE TUOLUMNE RIVER, CALIFORNIA.

The plate above has been engraved from a photograph selected from a number made of the La Grange dam, by Barr Ansley, one of the "INDUSTRY boys," who exchanged the composing stick for a transit.

From some notes sent, which we believe correspond with published descriptions of this fine work, we select the following: The dam is 130 feet high and 336 feet long, with a clear fall. The thickness at the base is 97 feet and at the top 24 feet.

The dam is in a cañon of the Tuolumne River, one and three quarter miles above the town of La Grange, and is built of granite in a most substantial manner. The whole work is laid in concrete, consuming 31,000 barrels of cement, an incredible quantity. This is said to be the highest "overflow" dam in the world, and is possible only because of the hard rock on which it stands. The purpose of the dam is to direct the water of the Tuolumne River for irrigation purposes.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO."

No. XXXII.

MACHINE TOOL MAKERS.—— FLEXIBLE DRILLING MACHINES.
GRINDSTONE FRAMES.—— BALANCING MANDRELS.
AN IDEA IN SALT CELLARS.

————At Seattle, Tacoma and Portland we went into various machine works, and as this is a field of especial interest to myself, I propose to fill up a section of the note-book with what was seen, and the impressions gained, especially the latter. It is a tolerably risky matter to criticise shop manipulation, because there are various ways of doing almost everything, and the best way is often a matter of opinion, determinable of course by wide experience and observation, but no one will accept such a determination.

The most unprogressive among all kinds of machine work is machine tool making. It is the branch to which is directed the highest skill, and in all countries is the field of the best mechanics, but for some reason tool makers come the farthest from logical conclusions of any class engaged in the machine business. There is about as much science in their art as there is in making worm fences in Virginia. They don't even know, and will not attempt to find out, the strains that occur in metal cutting, and of course never compute sections to resist strains, unless it be in a press or like machine. A lathe spindle may be two, three or four inches in diameter, and drilling spindles the same. This last mention brings up a particular point, noticeable in nearly all drilling machines, that of "torsional elasticity."

If a drilling machine is employed for boring, as is common in this Western country, its operative function is not much different from the head stock of an engine lathe, but if we look at the two we see a vast difference. It would be pretty hard for a tool maker to explain why he should not put the same gearing on a drilling spindle that he does on an engine-lathe spindle, but he does nothing of the kind, in this country at least. In England the rule was formerly, and may be yet, to use the same gearing for lathes and drilling machines, introducing in the latter a pair of mitre wheels to make the angle. This was a very good rule, and saved a good deal in patterns and drawings, produced a powerful machine with the tor-

sional elasticity confined to the mitre wheels and projecting spindle, not quite as stiff as a lathe, but near it.

Compare this with the back gearing on a second shaft, two to four feet long, and in the case of radial drilling machines on a second or a third shaft, sometimes with as much as ten feet of light shafting between the power and the work. A radial or a crane-drilling machine geared in this manner with a great sole plate, a heavy gib bar and a spindle two to two and a half inches diameter is a caricature on machine design.

If one asks a question he is informed that the drilling machine is a "powerful one," powerful for what? To revolve drills? For that is nearly the sole function to be performed. "Drills true" we are told. How drills true? A machine does not guide its drills. The drills guide themselves, and if there is deviation the machine multiplies the error, and makes it worse. Of course the work and spindle supports must be so sustained as to withstand the thrust of drilling, that is, the framing must not bend or yield, but as to lateral stability or guidance, these elements or functions are not provided by the machine at all.

Let us consider a drill itself as an implement. It has two short cutting edges balanced across its point or axis. These cutting edges are guided by four agencies: the burrowing point, the bearing of the edges themselves, the lateral fit of the drill in the hole and the support of the outer end by the drilling spindle.

Now among these elements of "guidance" what does the machine itself provide? It holds the outer end of the drill central with the hole "as it was started," presses it forward, and nothing more. If the drill deviates this support causes more deviation, as we can see in ratchet drilling. It is a blind following of the course. There is, however, another machine function, that of starting drills at a right angle to the plane of the table, convenient, and hence important, but with all allowances it is easy to see that a "powerful drilling machine" is an idea, not a fact, except as to force of revolution.

This divergence to drilling has used up about ten times the intended space, and we pass to grindstones. These I find mostly in wooden boxes or troughs, that by the nature of the material must be made of angular section, but some of the frames are made of iron, and have on the side the name of a notable firm of tool makers, but the form in this case is circular or semi-circular to fit around the stone. What for? This shape destroys the base,

and must either be expanded again, producing a new set of curves, or some kind of legs must be screwed on to get a standing base. The result is a grotesque-looking soup-bowl affair that costs a good deal for pattern making, and is inconvenient to mould, handle, and for use.

The "box" fits around the stone, so that if a tool falls in it will jam the stone, and cannot be got out. There is no room to catch water or hold sand, except a small pool in the center, from which the stone picks it up, and casts it out over the grinder or on the floor. Suppose that on the contrary these iron grindstone boxes were rectangular in form, ran straight down to a flange that rests on the floor, the corners affording space to hold water and sand. Such a form would look well, and be well; I have seen them and tried them.

——————I noticed the men grinding on the approaching side of the stones, and asked the reason. "Takes the wire edge off" was the answer. That settled it. A wire edge on a metal cutting tool is good. Where I learned my trade we oil stoned the tools after grinding, which it is true took off the "wire edge," but the object was something else. The tool was smoothed just at the edge and its cutting friction reduced, also was oiled.

The reason that men grind in front of a stone is that there is less pressure to apply, but this is a poor compensation for being slopped all over with dirty water, and running the risk of smashed fingers or worse. So it has always been in machine shops, but observe a professional grinder and see if he works on the front, to so call it. He would not think of such a thing, even if he were grinding machine tools.

——————To stop fault finding for a time, I happened today on a little matter or expedient that went far to direct attention from tool criticism, something so good that I felt compelled to hurry back to the hotel and submit it to my Uncle. It is a common, or so far as I know, the universal rule in balancing pulleys or wheels to fit them on a mandrel that fills the bore, and then roll the mandrel on the ways, marking the high or light side. These mandrels cost a good deal, and a good many are required for holes of different size. The thing I found was a man balancing pulleys with all kinds of bore on one mandrel. He would put a pulley of four inches bore on a two-inch mandrel or piece of shaft, and go on just the same. The rolling action seemed to be even more sensitive when the mandrel did not fit the hole. I was amazed, also disgusted. Here is my Uncle's idea of the matter:

"There is nothing strange in this, we are all slaves of habit, with a limited power of reasoning, and are always blinded by familiarity. No one reasoned that matter out. Some lazy fellow, or some one in a hurry, stumbled on that idea when trying to scamp work. I can see how it will do as well or better even, than if the balancing shaft fitted the bore, now that you mention it, but never thought of it before in forty years' experience. It is 'leaving off,' that is omitting parts, and is for that reason opposed to the natural idea or tendency to add on something, but the matter is not done yet. You have it down in your note-book, in your head and in mine, but there are by the census report about fifty-five million, nine hundred thousand, nine hundred and ninty-seven people left to learn it. How long do you think it will take for this to go around? Go back to that shop in five years from now, and you will perhaps find them carefully turning up special mandrels to fit the bore of each pulley or wheel to be balanced. It may require a pick to get a joke into a Scotchman's head, but it requires a pile driver to penetrate the crust of a custom.

"Please hand me that salt cellar? I want to use it for an illustration. It is a shaking one, and inside is a small battering ram to pulverize and loosen the salt, but even with that you cannot shake out any. It is caked hard, and from here to New York you will not find one much better. Salt absorbs moisture, and melts to the extent of the particles adhering together, "baking" we call it. Now what is a logical preventative for this? Obviously some substance to take up the moisture, starch for example. Put twenty per cent. of starch in the salt, and it will flow like sand or gun powder in all weathers. Do you think that is new? Not by any means, every fool should know this much, and hundreds, perhaps thousands, have been informed of it, but it remains in the occult field of the unknowable for all the rest. Now you can discern what is to become of your balancing mandrel problem."

This was hard, this ruthless theory of my Uncle, but it is true, and brings to mind the Hero engine of 300 B. C., just now in a modified form coming to the front as a motive machine, but there are exceptions, not in the useful arts unhappily. If the beaux on the boulevard in Paris put on square-toed boots, they will appear in Halifax and Sitka in course of mail. If hats have an inch added to their brim diameter, or as much taken off, the change goes directly around the world, and all imitate the fashion. It is only useful things that travel so slow.

——————I wonder what the reason may be why line shafting all over this country, so far as we have seen, is coupled with keyed-on flanges, not even clamp couplings. I brought up the subject once or twice, and in answer to inquiry brought out a discussion of the merits, cost, and holding power of compression and flange couplings, but no hint whatever that would show that people about here know what compression or clamp couplings "are for." This is just a little strange, when one finds, on the other hand, any number of ingenious expedients invented and applied to all kinds of purposes. No one, however, seems to have discovered that clamp couplings convert the making of line shafting to a "manufacture," and this is the key to any system of cheap production; but then, organized manufacture of any kind is in its germ state here, and must be for some time to come. There is no market to permit duplication, and here is the greatest impediment to local production. I am expecting to find other impediments before we get to San Diego, or the Mexican line, but there is one quality that goes far to compensate for organized industry, and that is a restless vigor and boldness that makes one man count for two in some other parts of this country.

(To be continued.)

TESTS WITH FUEL GAS.*

Made by the Southern Pacific Co., Sacramento, Cal.

BY A. J. TREAT, SAN FRANCISCO, CAL.

It can truly be said that neither the inventor nor the mechanical engineer has been backward in discoveries tending to greater economy in the use of steam. It is not an exaggeration to say that each day brings to life and to light some improvement in this branch of mechanics.

Unfortunately it cannot be stated that like progress has been made in the method of producing steam, though it must be patent to all that its economical production is just as important as its economical utilization. Improved triple and quadruple expansion engines, new valve gears and governors and condensers, each without number, and each warranted to effect a saving in the quantity of steam necessary to produce a given power, are urged upon the public with ever-increasing zeal, but comparatively little, if anything, is accomplished to effect an appreciable economy in the use of *coal*.

As a matter of fact it is doubtful if the most improved boiler of today equals in point of all-around economy the Galloway boiler of

* Reprinted by permission from the *American Engineer.*

twenty years ago. The latest style of water-tube boiler is far less bulky, and a more rapid steamer, it is true, but if the question be as to dry steam and the life of the boiler, as well as the evaporative efficiency, some of the old-fashioned affairs for the raising of steam are about equal to the water-tube boilers of today.

The difficulty in the way of a nearer approach to the obtainment of the theoretical value of coal seems to be largely one of principle. The system of burning coal today is practically that pursued in the days of Stephenson, and the difficulties which then presented themselves have been but partially overcome. Let us briefly review the process:

When fresh fuel is thrown into a furnace, decomposition begins first on the surface of the lumps, the moisture, of which there is always a percentage present, together with the volatile matter contained in the coal, is freed. While yielding up this volatile matter the fresh lumps absorb heat until they become incandescent. Unfortunately this absorption of heat, and this giving off of volatile gases occurs at a time when it is impossible to supply to those combustible gases the air necessary to their complete consumption. The particles of coal freshly thrown in lay in a mass, more or less preventing the ingress of the fresh supply of air, while the grate bars, clogged with ashes, add to the difficulty by keeping back the necessary supply of oxygen, which should freely pass through them, and which is so vitally essential to the consumption of the volatile gases rising in clouds from the fresh coal.

In the endeavor to overcome these difficulties, which are incident to and inseparable from the ordinary method of burning coal upon the grate bars of all the standard forms of boilers, a supply of air is admitted which is far beyond what is theoretically necessary. To obtain this supply huge chimneys are constructed, the openings for air below the grate bars—the ash-pit doors—are enlarged, or, what is least objectionable, a forced draught of air is employed.

The complicated series of gases, known as hydrocarbons, set free during the decomposition of coal resulting from heat, rise, as suggested, in largest quantities when it is least possible for a supply of air to reach them. Not receiving the necessary supply of oxygen at the proper time they are carried up the chimney and into the atmosphere. A large volume of gas, capable of giving out heat, could it have been retained and properly mixed with air, is thus lost.

A single lump of coal thrown upon an incandescent bed of coals is thoroughly consumed, and nearly all its hydrocarbons utilized, because there comes to it with but little interruption sufficient heat and a sufficient supply of air. But when there is thrown into a furnace a charge of coal, the fresh layer forms an intervening mass between the hot bed of coals and the gases above. In consequence these gases, lacking the air necessary to their consumption, separate, pass up the chimney, and give forth the finely-divided particles of carbon as smoke. The cause and effect is similar to that of a lamp wick which has been turned too high—the gases of combustion

are in excess of the air, which is necessary to complete consumption.

It is not necessary to enter here into a discussion of the "smoke nuisance." By careful firing smoke can be allayed, but under present systems it cannot be prevented. A mistaken idea exists as to the amount of actual carbon contained in those dense masses of smoke which are seen rising from the tall stacks of manufacturing and other large plants. By passing through water the gases arising from a furnace burning bituminous coal, and weighing the particles retained or precipitated, it has been proved, it is claimed, that they amount to less than one sixth of one per cent. of the total amount of coal consumed. It is not strange that a different idea is entertained of the quantity of actual carbon seemingly going to waste when the wonderful coloring power of the finely-divided particles of carbon is considered. To prove this it is only necessary to try the well-known experiment of smoking a bit of glass with a candle, and then mixing up with a palette knife a portion of the coloring matter thus secured with a drop or two of gum arabic. A very small portion of this mixture will color many quarts of water, and in the same proportion that the air is discolored by the dense volumes of smoke issuing from the average factory smoke-stack.

Smoke then is the result of a condition which can be remedied to some extent, but not under present conditions of burning coal materially changed. Smoke is both the result and the evidence of incomplete combustion. The actual carbon contained in the smoke itself is inappreciable, but the unconsumed invisible gases invariably associated with the smoke are considerable in quantity, and indicative of a financial loss much larger than is generally known.

While it has always been understood that the generation of heat from coal, as ordinarily obtained under a boiler, was imperfectly carried on—that the gases were not, and under the conditions could not be, thoroughly mixed with that quantity of air necessary to their complete combustion—singularly but little attention has been paid to possible variations of the method ordinarily employed.

At lest theoretically the system of heating by gases generated in a producer carries with it the remedy for the shortcomings of the grate system of firing. The difficulty heretofore, however, has been in the practical application of the system.

The process of combustion here to be considered, as first introduced, and which has not been materially changed, consists in distilling or volatilizing the fuel in a producer, thus turning it into its carbonic oxides and hydrocarbon gases. The first experiments with fuel gas were highly successful in the gain in evaporative efficiency, but the attempts heretofore made to introduce the system commercially have failed, mainly because of the expense formerly necessary to maintain and equip a plant, and also because more skilful handling has been required than could be expected of the average fireman found in the boiler room.

The foregoing observations upon combustion have been made somewhat in the nature of a preface to the following remarks upon

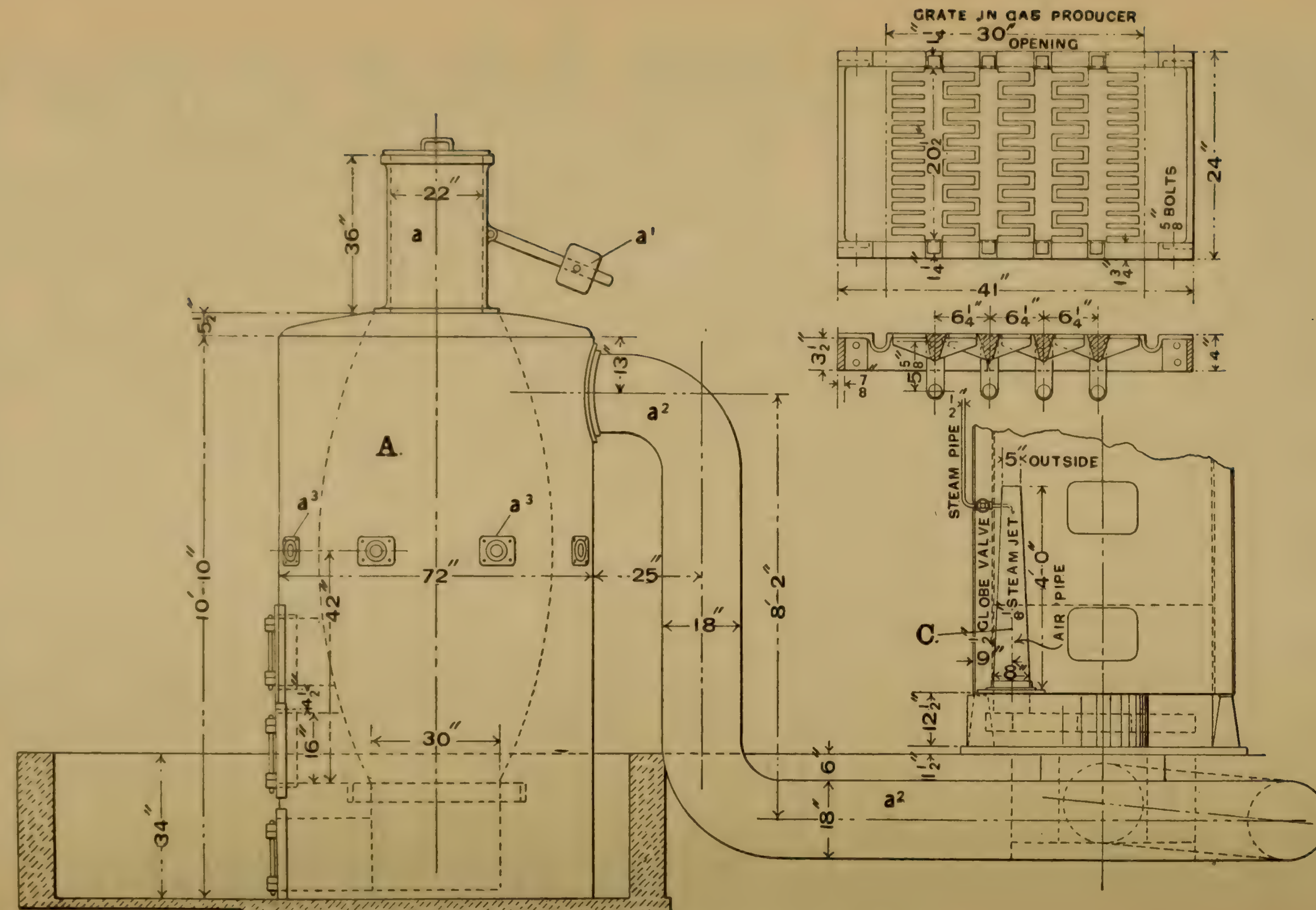


FIG. 1. ELEVATION OF FUEL GAS PLANT.

and extracts from a series of experiments conducted upon lines differing slightly from those generally in vogue. The tests referred to were recently made in the works of the Southern Pacific Company, at Sacramento, Cal. The object in view was the determination of the economy of fuel gas as against grate-bar firing, and particularly to test a patented furnace specially designed by the company with which I am connected, for the purpose of utilizing cheap coal (Ione lignite).

The tests were made by Mr. Howard Stillman, Engineer of Tests, under the direction of Mr. H. J. Small, the Superintendent of Motive Power and Machinery. The following extracts, tables and diagram are from the report of Mr. Small to Mr. W. G. Curtis, Assistant to the General Manager:

SACRAMENTO, February 20, 1895.

W. G. Curtis, Assistant to General Manager:

DEAR SIR:—Great care was taken to obtain actual data, and I can say that the report very clearly exhibits the merits of the device, and we can safely say that the best efficiency from Ione coal can be obtained by its use in a gas producer. Carbon Hill does poorly in the producer, while Nanaimo does well.

Yours Truly,

(Signed) H. J. SMALL,

Superintendent of Motive Power and Machinery.

SACRAMENTO, February 11, 1895.

H. J. Small, Esq., Superintendent of Motive Power and Machinery:

DEAR SIR:—With each fuel the tests were made on three consecutive nights, from 6 P. M. to 6 A. M., the boilers supplying steam to run the electric engine. The boiler used was of locomotive type,—same one as used on previous tests with gas producer—and one of a battery of three.

The test boiler was so connected as to supply steam to the electric light engine alone, although one or more of the other boilers could be cut in if necessary, as when steam pressure fell down below 40 pounds, owing to any cause.

Except with Nanaimo coal the producer had to be cleaned out and started again at midnight of each test, a process requiring from ¾ to 1¼ hours. Under these conditions the steam pressure fell off, and it became necessary to cut in the other boiler as stated. The action of producer was irregular at times owing to conditions producing a varying quantity of gas, conditions varying again with each fuel used. For these reasons it became necessary to study the action of each fuel in producer, and the "personal equation" entered largely into matters of successful operation. It will be understood that producer was in operation some time on working days, and trials and experiments made with each fuel to endeavor to obtain the best results. At such times the firemen in charge were instructed, and during the tests it was essential to have the same man run the producer to obtain uniform results in operation. The man in charge during the tests was allowed to run the producer without expert assistance. The Ione coal acted fairly well in the producer; the amount of heat generated in the producer was not great, and a pipe conveying gas to the boiler was easily kept from redness. The great accumulation of ashes from this fuel required a longer time at midnight to clean out, as above referred to.

Carbon Hill coal gave much trouble, owing to difficulty in keeping the mass in producer from getting intensely hot. The gas convey pipe was red hot most of the time. To avoid this tendency the production of gas was "dragged" often to the extent of diminishing steam pressure in boiler. This again required the cutting in of other boilers to supply the deficiency, and accounts for a larger proportion of time during tests with this fuel, in which the boiler was aided as shown. The accumulation of ashes, coke and clinker with Carbon Hill was also a source of midnight delay.

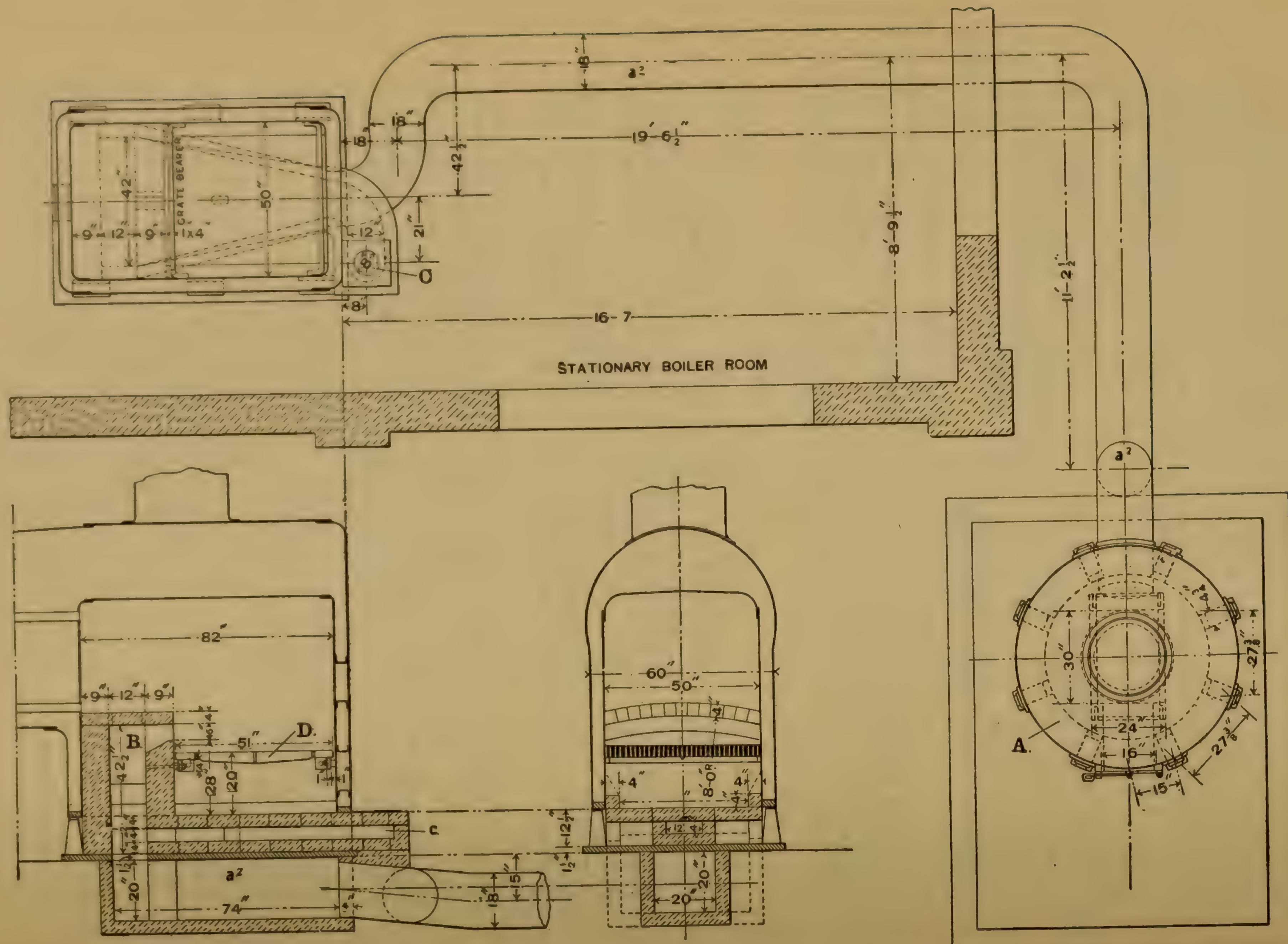


FIG. 2. PLAN AND SECTION OF LOCOMOTIVE BOILER USED.

Using Nanaimo coal, the producer gave no great trouble with overheating of the mass. The quantity of ash and clinker was not sufficient to require cleaning out during period of 12 hours' test with this fuel. Steam pressure was not always up to standard, but the proportion of time the boiler required aiding was small compared with the previous fuels tested, as will be seen.

It would seem to have been shown by the tests that the producer as constructed (blue print of arrangement of which accompanies report) was not large enough to supply this size boiler.

On completion of tests with gas producer it was disconnected, and the regular grates placed in fire-box of boilers. A series of tests was then made with same fuels burned in usual manner. The figures shown in attached tabulated statement are totals and averages of three tests with each fuel and method of combustion, a total of thirty-six tests having been made.

(Signed) HOWARD STILLMAN,
Engineer of Tests.

A description of the apparatus is here necessary to understand the tabulated report of Mr. Stillman.

The gas producer *A* was of the ordinary pattern, fitted with a shaking grate-bar, such as is used in locomotives. Two steam-jet pipes (not shown) were arranged to the right and left of the ash-pit and cleaning doors of the producer, with valves regulating the supply of steam in the jets, and thus the supply of air entering the burning mass of coal *via* the ash-pit.

Comparative Test with Fuels in Gas Producer Connected to Stationary Boiler and Burned on Grates of the same Boiler in the Usual Manner.

[Boiler supplying steam for electric light engine only.]

Kind of Coal	Ione.		Carbon Hill.		Nanaimo.	
Method of Combustion	In Producer.	On Grates.	In Producer.	On Grates.	In Producer.	On Grates.
Gallons Water Evaporated	9,280	9,475	6,200	10,090	9,834	10,634
Pounds Water Evaporated	76,704	78,927	51,648	84,050	81,920	88,582
Pounds Coal Burned	29,440	33,060	9,000	13,790	11,200	14,888
Average Steam Pressure	63.4 lbs.	68.4 lbs.	60.0 lbs.	68.7 lbs.	64.4 lbs.	75.7 lbs.
Average Temp. in Smoke-Arch of Boiler	460° F.	503° F.	475° F.	551° F.	518° F.	515° F.
Temperature Feed Water	58° F.	49° F.	48.6° F.	47° F.	50° F.	49° F.
Evaporation:—Pounds Water to Pound Coal	2.61	2.40	5.74	6.09	7.31	5.95
Equivalent Evaporation from and at 212°	3.10	2.88	6.89	7.21	8.77	7.16
Duration of Test	36 h.	36 h.	36 h.	36 h.	36 h.	36 h.
Percentage of above time during which boiler was able to maintain steam pressure unaided by other boilers (above 40 lbs. required)	73.6	100	45.3	100	98.4	100
Pounds Water Evap. per sq. ft. heat surface	80.0	81.6	54.6	87.1	86.5	90.5
Cost per 1,000 Gallons Water Evaporated	$2.38	$2.60	$3.77	$3.54	$3.01	$3.64
Per cent. saving in cost per 1,000 Galls. Evap.	8.4	....	....	6.5	17.3	....
Cost of Coal per ton	$1.50		$5.20		$5.20	

The coal was fed into the producer by the hopper a, arranged with the usual cone valve and counter-weight a^1, the products of combustion escaped through the outlet pipe a^2 to the combining chamber B back of the bridge wall. Peep-holes a^3 were arranged in the outside of the producer at intervals to admit of a bar to break up clinkers.

Air was admitted or rather forced through the steam-jet pipe C into the passage c, where it met and intermixed in the combining chamber B with the hydrocarbon gases from the producer.

A fire was ignited upon the grate D, and, in addition to raising the steam to a starting-point, served to light the product from the producer when the same was rich enough for combustion, after which it was allowed to die out.

The results of the tests, and particularly the 17-per-cent. increase in the performance of the Nanaimo coal, as shown in the table, are not by any means unsatisfactory, especially when it is considered that the boiler was not the best one adapted to the tests, being of the locomotive pattern, originally intended for a river steamer. More satisfactory results would undoubtedly have been had with a boiler of the return tubular type, for then the hot gases would have had an opportunity to expand and develop their greatest heat in the combustion chamber behind the bridge wall, before final extinguishment in the tubes. With the combining chamber arranged as shown, in a boiler other than one of the locomotive pattern (which in this instance seriously cut down the heating area of the fire-box), a fire could also have been kept up upon the grate bars when the producer was not in use or during the period of its cleaning.

A better and more economical result would also have followed the use of dry air, such as could have readily been had from the forge blast near by, instead of the forced draft of moist air through the steam jet pipe C.

The particular use to which the boiler was put—that of driving an electric plant—made it difficult, with only one boiler, to properly clean out the producer at the time it became necessary without a loss in the average steam pressure, and a resultant falling off in the showing of the evaporation of water. Carbon Hill coal, however, has always shown a tendency to clinker, while the difficulty with the accumulation of ashes from the Ione coal will be understood when it is stated that its evaporative efficiency, when compared to Nanaimo, is as 1 to 3, so that in bulk three times as much would have to be used. (See table of analysis of coals.)

It will be noted from Mr. Stillman's report, that the person in charge of the plant was the ordinary fireman. Usually tests like that described, are either conducted under the supervision of an enthusiastic inventor or the watchful eye of a mechanical engineer, and the results obtained by them experimentally are seldom equalled in practice.

It is not uninteresting to note that the method of arranging the combining chamber behind the bridge wall is one applicable to mos

any boiler, and that, as the grate bar is not disturbed, either method of firing can be adopted according to the time the boiler is to be run.

The report of Mr. Stillman does not state that the operation of the boiler was smokeless; nor could that fact have been readily determined, for the boiler was one of a series using a common chimney. That the producer method of firing a boiler, however, *is* smokeless is a fact so well known that the statement in itself is superfluous.

Analysis of the coals tested.

[From S. P. Co's Analysis of Pacific Coast Fuels.]

	Ione.	Carbon Hill.	Nanaimo.
Moisture	42.58	2.16	2.25
Volatile matter	34.88	31.73	36.05
Fixed carbon	17.42	55.80	51.95
Ash	5.12	10.31	9.75
Total	100.00	100.00	100.00

THE GREAT GERMAN CANAL.

The press was filled at the end of last month with accounts of the opening of the North Sea and Baltic Canal from the River Elbe at Brunsbüttel, a little distance below Hamburg, to Kiel on the Holstein Peninsula, a port which formed the principal object of the Prussian acquisition of the Schleswig-Holstein country thirty years ago. Previous to that the Danish country came up nearly to Hamburg. Altona, three miles away, then and now a suburb and portion of Hamburg, was a Danish city, and might have remained one if Denmark had not too long hung on to the traditions of the past, denied her people a free constitution and possessed that curse of all small nations, an army and a navy. She accordingly set out to do battle with Prussia, and in so doing lost the coöperation and support of neutral powers. It is an idea of our own, and of times long past, but there is no doubt but what England would if Denmark had not taken the sword into her own hands, said to Prussia: "Denmark is our relative, a small power, let the dairy peninsula alone."

Having Kiel to make a great naval station in the Baltic waters, Germany set out at once to improve it, but there was one serious

natural impediment that in a great measure affected Kiel as a naval station, and one that always affected commercial trade to the Baltic, that of sailing around Jutland, through the foggy Skager-rack, the dangerous Kattegat, and the narrow sound three miles wide at Helsing-ör, or "Elsinore," as we call it now, the place where Hamlet's father walked in the night.

One might search the whole world to find so foul a bit of navigation as this around Denmark, for all the winter months. Sometimes a steamer will work "on and off" the sands of Jutland by soundings for days at a time, or even for a week, until her coal is all burned out, and then be blown out of the "Skaw" into the North Atlantic, and if she does not happen to hit the Orkneys, Shetland or Faroe Islands, goes where the *Colima* did. This happened some years ago to a steamer of the Dudgeon Line, an old blockade runner of the "tin-pot" order, that got under the Faroe Islands by burning her cabin furniture and bulkheads to make a final effort at life.

The "Sund" at Elsinore may freeze over, and the winds may hold the traffic there for days, sometimes hundreds of vessels are weather bound there. We have heard it claimed that a thousand sail can be seen at times, and believe it. With these reasons existing it is no wonder the German nation cut a canal sixty miles long across the Holstein Peninsula, affording safe and easy transportation instead of seven hundred or more miles around the treacherous coast we have been describing.

The great canal follows in part an older and famous work called the Eider canal, and was projected in 1865 by Herr Lentze. For many years, ever since in fact, it has been the subject of careful study by both government and civil engineers in Germany. There is a good deal of difficulty in respect to water levels and currents. Most people think of a sea canal as one without locks, an open clear cut, but the tides interfere with any such scheme as open-end canals.

There are no tides in the Baltic Ocean. These cease in the Kattegat, or the Danish Channel. Even at Gothenburg, in Sweden, there is no trace of the tidal wave, but the water at Kiel is nine inches below low water at Brunsbüttel on the Elbe, where there is nine feet of variation between high and low water. This calls for locks at each end of the canal, which is otherwise a dead level of 61.3 miles, of which two thirds is a direct air line.

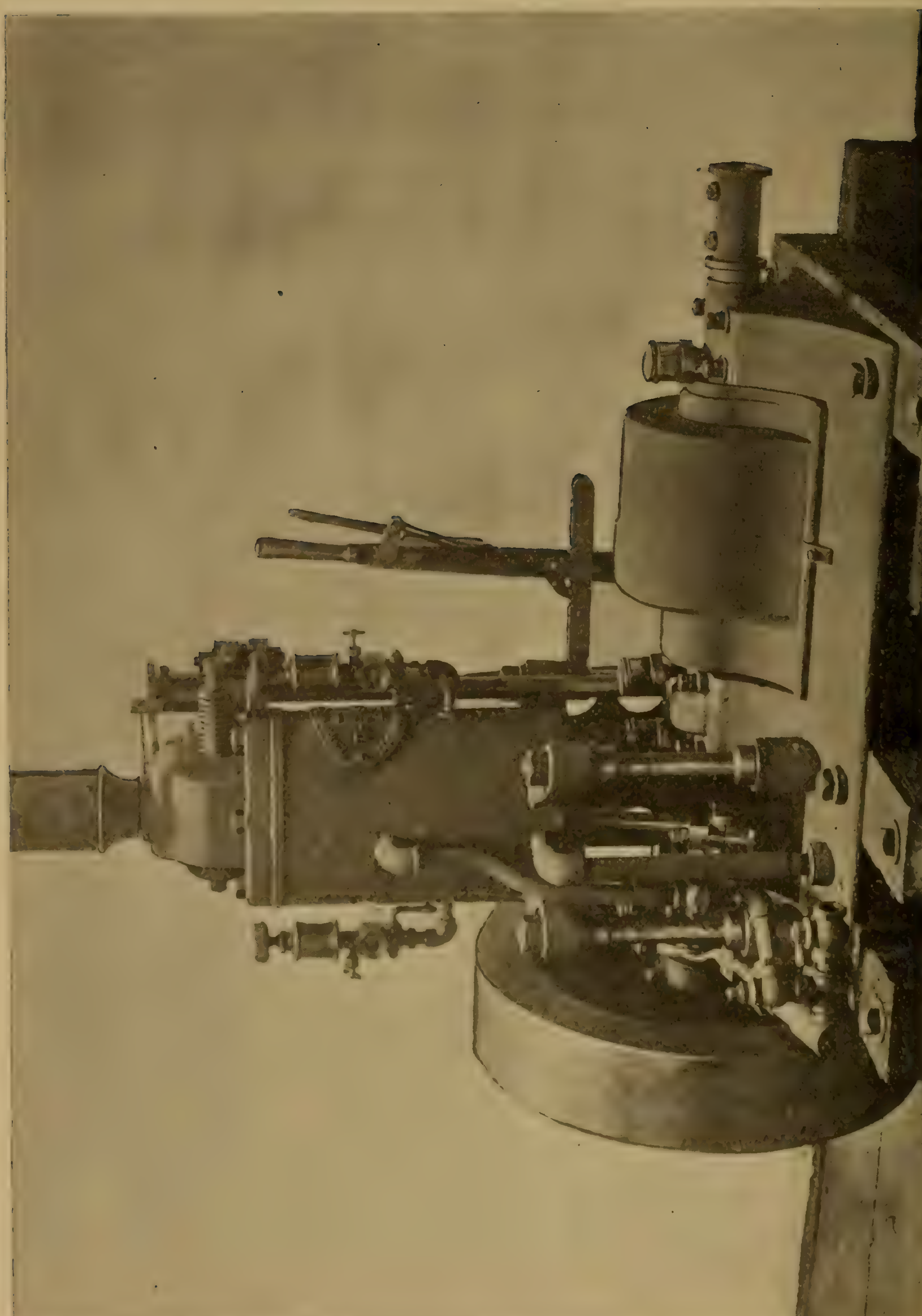
There is also another matter that interferes with water levels, the wind. It is true that at Kiel the prevalent course of winds is such that no great disturbance may occur, but in bays and estuaries

opening to the west and south the water may be driven up to equal a small flood tide. We speak from observation of the matter at Gothenburg, but without remembering the height of these wind floods, but think they may reach two feet or more.

The great canal is on the bottom 118 ft. wide; is practically 30 ft. deep and will pass the largest war vessels, that have now in the German navy a draught of 28 feet. There are two high bridges across the canal, one of 513.6 feet span, with a clearance of 138 feet. There are also a large number of ferries wherever roads have to cross. It is a wonderful work, where sometimes the working force reached 8,000 men. The material moved was 100 millions of cubic yards, and, strange to say, the stability through marshy lands is gained by sand filling. The walls are covered in various ways with broken bricks, stone, cement slabs and masonry.

It was a national work, as all such things should be. No highway, especially one of navigation, should be controlled by private interests, and if this country instead of tampering with private interests would proceed to make the Nicaragua Canal, that work might be carried out in an equally successful manner. It is true that the German canal was made within the empire, and under the most favorable circumstances, but this need not have hindered the losses and scandals that would have arisen if there had been private interests involved. A centralized form of government has its advantages in works like this, not necessarily, but in fact, at this day of ours.

The parade of war ships, which symbolize the destruction of commerce, if anything, illy blended with the German Emperor's several remarks concerning peace, but war ships were the only kind available. Merchant ships are in their services attending to their own business, and war ships have no other function than to convey visitors, display bunting and keep the national treasuries depleted. Naval armaments are a necessity of war, but war itself is not a necessity at all, and can never again become a "deliberate" policy of any civilized nation, so we are disposed to set down as the most important fact in the opening of the North and Baltic Seas Canal the German Emperor's marked expressions relating to peace, and believe them sincere.



10 H. P. Marine Gas Engine.—Union Gas Engine Co., San Francisco.

TEN HORSE POWER MARINE GAS ENGINE.

THE UNION GAS ENGINE CO., SAN FRANCISCO.

We have had occasion several times to speak in terms of commendation of the marine engines made by the Union Gas Engine Company, of this City, and present opposite a plate showing an engine of the latest design for driving a screw-shaft.

It will be noticed that the total height and center of gravity are reduced to the lowest possible positions for a vertical engine, and the reversing gearing has been so arranged as to connect the screw-shaft and engine directly, for the forward running motion.

The struts between the main cylinder and bed plate form an unbreakable and convenient frame, that permits free access to the crank and main bearings. This construction, which presents difficulties when the work has to be laid out and worked to lines, is now performed by templates and special apparatus almost as cheaply as cast-iron struts can be made.

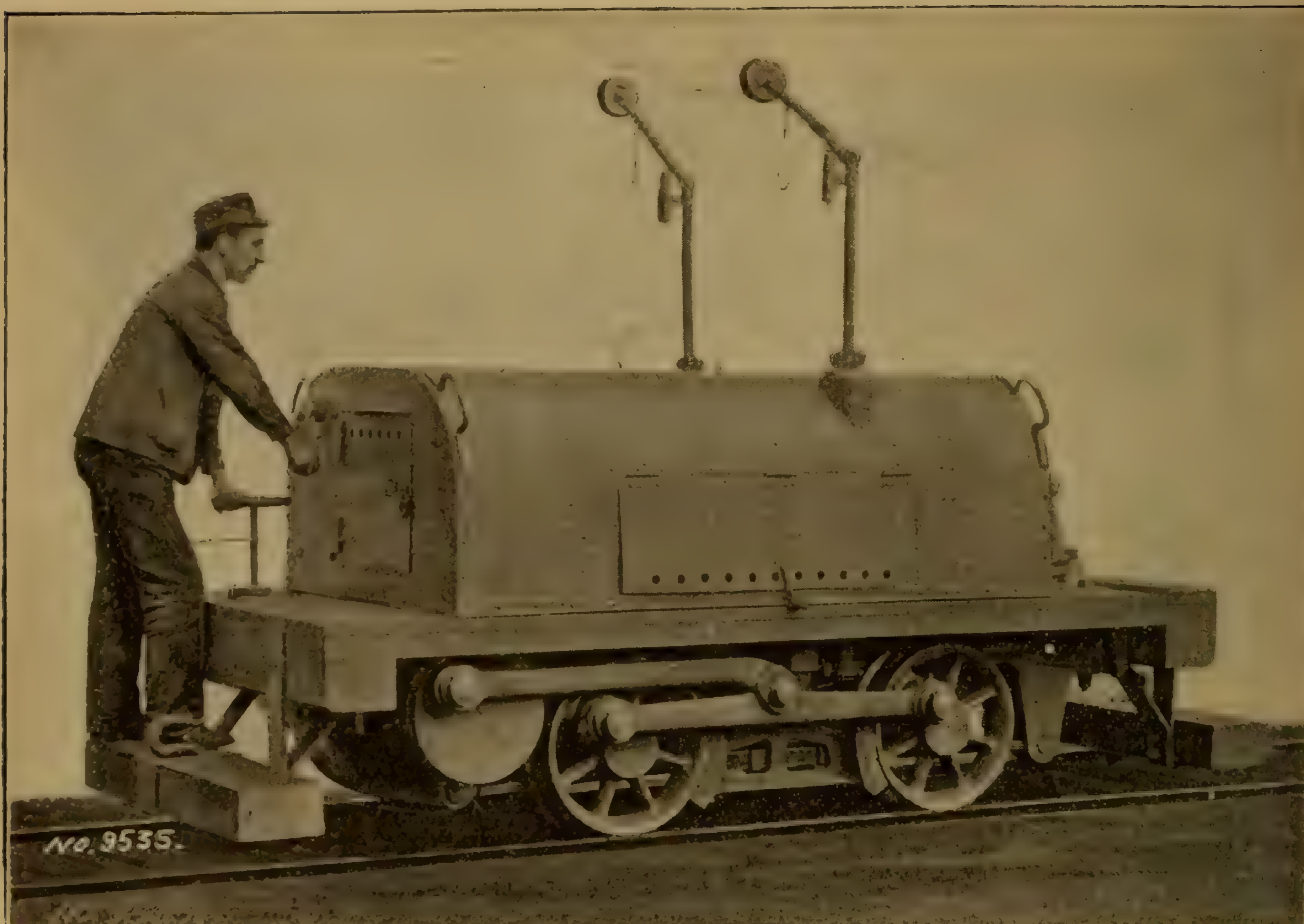
This strut method, it is plain to be seen, is to be a very constant characteristic of marine engine construction. The fast torpedo boats have their engines arranged in this manner, so also some of the war vessels, the *Warspite*, British cruiser, among the number.

The Union Gas Engine Company have by stages, and through the usual course of evolution by experience, succeeded in a very complete adaptation of these engines to the purpose of propulsion, and this, it must be remembered, has not been, as in the case of steam engines, a following of and adaptation of precedents, but worked out originally, except as to a limited number of such engines fitted in vessels abroad.

In the engine shown in the plate, and other sizes of similar design, the control is complete in starting, stopping and backing, with the single lever seen on the right, thus exceeding a steam engine in the simplicity of handling, there being no throttling valve or condenser to deal with.

The particular features of the engines are set forth in the company's circulars, and sent to those interested in these matters.

The Eastern branch, called the Globe Gas Engine Company, at Philadelphia, has recently erected new and commodious buildings, and is fast building up an extended trade there, enjoying, as we believe, many advantages in skill, implements and material which that great manufacturing city affords.



STEAM AND ELECTRIC LOCOMOTIVES.—THE C. W. HUNT CO., NEW YORK.

INDUSTRIAL RAILWAY LOCOMOTIVES.

THE C. W. HUNT CO., NEW YORK.

It is not strange that the construction of railways for the transfer of material about works, should become a separate industrial branch of engineering manufacture, but it is strange that any one should engage in a business so perplexing as to involve locomotives of ten to thirty tons, and trains of corresponding weight, to work around curves of twelve feet radius, on gauge width of 21½ inches.

These internal railways are a necessity, economically at least, in all kinds of large establishments where material or fuel has to be moved about, and this includes nearly all. Nearly everything entering into the construction of such lines is peculiar, and as before remarked it is not strange that the business of constructing such railways has become a distinct branch.

The C. W. Hunt Company do not confine themselves to these internal railways, but it forms a large and important part of their product, now reduced to a system, in so far as locomotives, the permanent way, rails, curves, switches, turn-tables, crossings, and so on, these being made in units, and furnished at regular prices the same as other standard machinery.

Our present purpose is to speak especially of the locomotives, such as are supplied for these industrial or internal railways. Two of these engines are shown in the plates opposite, one a steam and the other an electric locomotive, adapted to work on a line of 21½ inches gauge, and as stated around curves of 12 feet radius.

This latter, which seems impossible if we compare with a common railway, is ingeniously accomplished by causing the outer wheel to run on its flange around short curves. The proportions are so made that the added diameter of the wheel thus gained makes up for the difference in the length of arc on the two rails.

The steam locomotive shown below weighs 11 tons, and as seen, is built on the Fairlie or duplex system, the forward and rear trucks being driven by separate pairs of engines. In this manner the wheel base is contracted to the shortest limit, and the whole weight of the engine rests on the driving wheels.

To meet the extraordinary conditions of use, and to avoid frictional resistance on the short curves, there are provided a great many ingenious expedients that cannot well be described without drawings. The general view however conveys a tolerably clear idea

of the arrangement. Both water and fuel are carried in sufficient quantity to answer for a long run, or for five to ten hours service.

Electric locomotives are made for use on these industrial railways in works and mines. The one shown in the plate is of the mining type, having but one truck, but other modifications have double trucks the same as the steam locomotive in the lower drawing.

There is a single pair of gear wheels, the armature gearing into a large wheel on the rear shaft above the plane of the axles, and connecting rods extending to the center of the coupling rods, as shown in the drawing.

These locomotives are typical of the special character of the other elements entering into the system, if it can be so called, because nearly every plant requires special modification of some kind.

THE OLD MASTER MECHANICS.

[COMMUNICATION.]

TO THE EDITOR OF "INDUSTRY," *Sir:*— I have taken great interest in your articles on the "Old Master Mechanics," and perhaps more so as I was somewhat acquainted by tradition, which was then quite fresh, with many of the subjects referred to, and by actual association with some others.

It was a common belief in London during the 40's that a man who had taken his degrees as a turner in Maudsley's shop could not work a lathe in any other shop, where they did not require two wooden props under each headstock and one under the slide rest, which were said to be required with Maudsley's lathes, which had a triangular bar for the bed, similar to those in use in some kinds of small lathes.

I had heard that Clement had the first planing machine and it was still in use in his shop, but that it would be a smart man who would get to see it. It is said that all things come to him who waits, and it was so in my case. In the shop where I worked they were building some machines for cutting India rubber into threads of different sizes, and as it did not occur to the party who designed the machines to use change wheels, he called for a different pitch of screw for each change, requiring screws with 40, 60, 80, and 100 threads to the inch. There was at that time, about 1845, no shop in London that could cut those threads except Clement's. I was sent with the bars and brass nuts to Mr. Clement's to get them cut, and having found the old gentleman, who wore glasses and a long white apron, he gave me back the bars with instructions to our folks

to turn the bars nearly to the size first, as he did not do that rough work in his lathe, and above all to drill and countersink the centers.

His place was in the Borough, on the south side of the river from London, and was on a very wide road, the houses being almost all surrounded with gardens, and his was so situated, with the shop in the rear.

On the second occasion, having the bars centered and turned, I watched for Mr. Clement being away in the house, and went into the shop to find him. There was the planer, set on masonry, with two uprights built into the shop, and the table running on turned rollers. The cross slide did not appear very different from others then in use. Soon after Mr. Clement appeared and stopped further investigations. He took the work in hand, after berating me for coming into his shop without permission, which I took in good part, as I had seen enough to pay for it.

When the screws came back they were a beautiful job; they were about one inch diameter and about one foot long in the thread, with brass nuts about two inches deep; the threads, fine as they were, were nicely rounded on top and bottom, and they were just as good a fit as they possibly could be.

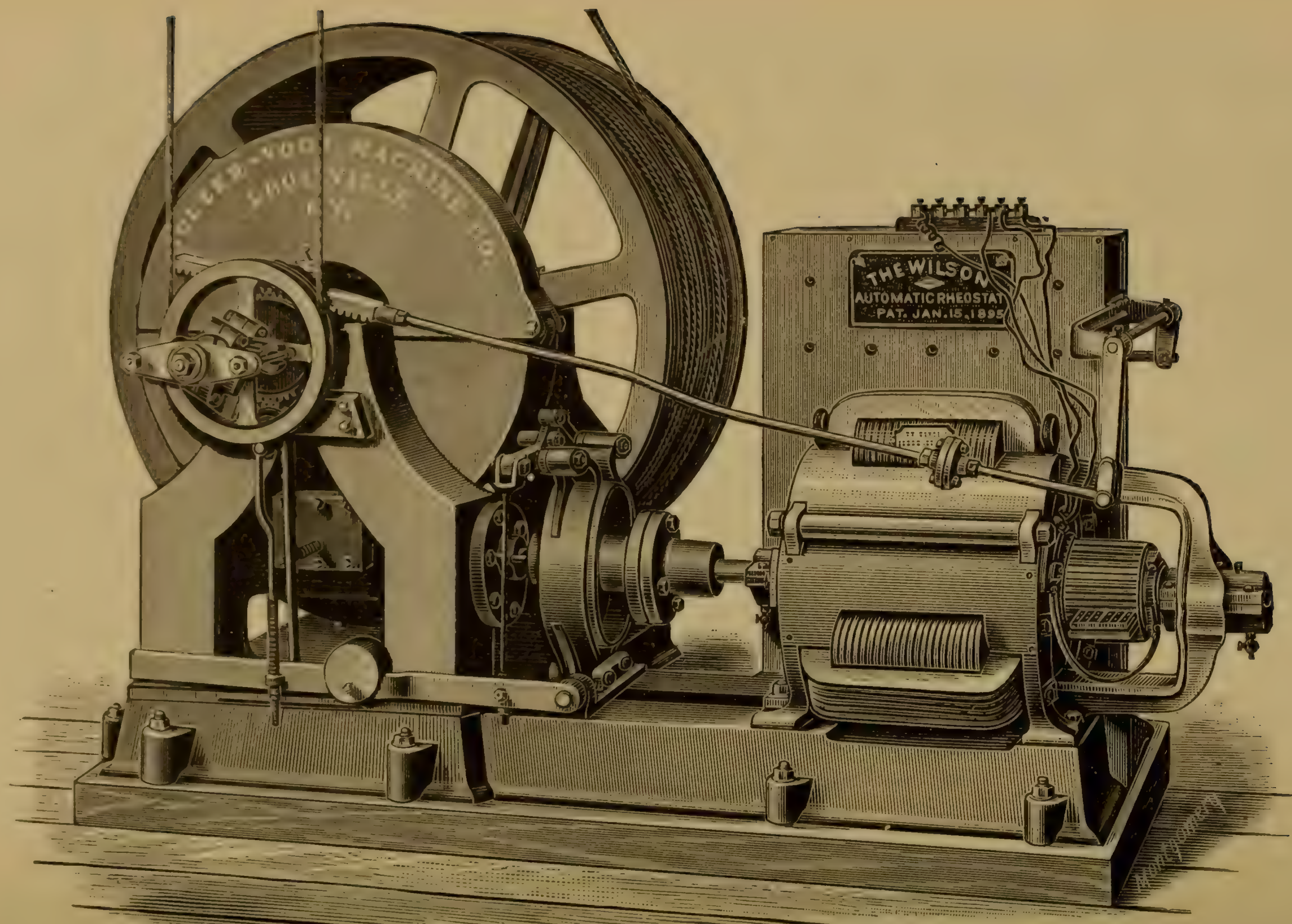
We used for very particular work to have our brasses lined with Babbitt, or as it was then called, "anti-attrition metal." We did not do it ourselves as the composition was a secret, but we would fit our brasses, bore each end to the size of the shaft or pin, recess the rest, and tin the whole interior surface. They were then taken to the filling shop where they used to fill them twice a week, and I really do not think that I have ever seen better work and metal than that was, and rarely as good.

I used some reamers at one shop in London which were called Bodmer's reamers, but whether the same as you refer to I do not know. They were a turned cylinder with about a fourth of the circumference removed, leaving one cutting edge. They did splendid work, but were difficult to temper without springing.

I have seen one of Bodmer's circular planers, and think I have a drawing of it somewhere. It turned about four feet diameter, and the frame was a half cylinder above the face-plate, with a hemispherical top. It was very solid and did good work.

This is not written for publication unless you think it advisable, but just to add some facts of the same kind to those which you have so pleasantly presented already. WM. J. SILVER, M. E.

Provo, Utah, June 20th, 1895.



Electric Passenger-Hoisting Machine.—The Sulzer-Vogt Machine Co., Louisville, Ky.

ELECTRIC PASSENGER-HOISTING MACHINE.

THE SULZER-VOGT MACHINE CO., LOUISVILLE, KY.

We are somewhat astonished at receiving the above drawing and explanatory matter thereof, from the Sulzer-Vogt Machine Co., at Louisville, Kentucky, and are glad to publish it as an example of present practice in a branch of engineering work just now in a state of evolution, so to call it. To any one acquainted with hoisting gearing and electrical apparatus the drawing will be clear throughout.

The following description is taken from the Company's circular:

"The worm and worm shaft are turned from one solid steel forging. The worm gear is of the best anti-friction bronze, accurately turned and cut by a machine made for this special purpose, and is enclosed with the worm in a cast-iron case, and run in oil, which insures perfect lubrication and smooth running.

The drum is of an extra quality of cast iron, of large diameter, turned and grooved in the lathe for the requisite number of lifting cables, and is bolted entirely to the worm wheel in the most substantial manner.

The brake wheel is keyed rigidly to the worm shaft, special care being taken to secure strength as well as smooth working in all parts of the brake apparatus. Both the brake, lever and switch are operated by the operating cable in the hatchway or the lever device in the car. Their movements are so timed that the instant the electric current is switched in the motor the brake is released, and the instant the current is shut off the brake is applied.

The motor is of the multipolar type, slow speed, long bearings, self-oiling brass boxes and self-adjusting carbon brushes, which require the minimum attention. It is constructed especially for elevator work, having great starting power and durability. It has proven its fitness for this class of work, and its thorough reliability on the number of elevators we have erected. It has a large margin of power, and regulates itself automatically."

There are a number of ingenious points involved in the mechanism, and evidently surplus power in the motor. The mass of resistance coils, indicated by the large case behind, confirms the claim for electrical control. We note also from the descriptive notes that in addition to automatic stops for the extreme range there are also such stops for cable-slack stoppage, that is, if the cage becomes jammed in its descent the machinery stops without paying off slack cable above the cage.

It is not quite discernable at this time what the ultimate plan

for reducing gearing for electric elevators will be. There are certain conditions, such as safety against running back, that favor tangent gearing, and this very quality indicates a large amount of friction, not so much, however, as is commonly supposed if the gearing is well made, and in this lies the main point of all. The present machine, from the description of the gearing quoted, seems to be carefully made in this respect.

THE WAGES PROBLEM.

A very remarkable and advanced paper was that of Mr. F. W. Taylor, of Germantown, Pa., read before the American Society of Mechanical Engineers, at the Detroit meeting last month, on the subject of wages. The ideas presented are in part as to fact, and wholly as to spirit, in consonance with what has been argued in "INDUSTRY" for seven years past respecting work, wages and the labor problem.

The paper was entitled a "Piece Rate System," and related to what the author calls a "differential rate" of wages, based on paying for work performed in proportion to the rapidity and character of its production. It is not easy to understand, and still more difficult to explain, the author's views, not from a fault of his, because his paper is especially perspicuous, but from the fact that the subject is too novel for easy understanding. From the dawn of civilization to our time the relation of employer and employed has included a large portion of the human family, nearly all of it indeed, but notwithstanding this there is not one in a thousand who has fixed and intelligent convictions respecting the subject of labor and wages.

This the author has foreseen, and he has divided his paper into ninety-two numbered sections, and at the beginning for reference gives a classified list of topics embraced and discussed. To attempt some explanation of this remarkable paper we will go to nearly the end of it, and quote Sections 79 to 83 as follows:

"79. The first case in which a differential rate was applied furnishes a good illustration of what can be accomplished by it.

A standard steel forging, many thousands of which are used each year, had for several years been turned at the rate of from four to five per day under the ordinary systems of piece-work, 50 cents per piece being the price paid for the work. After analyzing the job, and determining the shortest time required to do each of the elementary operations of which it was composed, and then summing

up the total, the writer became convinced that it was possible to turn ten pieces a day. To finish the forgings at this rate, however, the machinists were obliged to work at their maximum pace from morning to night, and the lathes were run as fast as the tools would allow, and under a heavy feed.

It will be appreciated that this was a big day's work both for men and machines when it is understood that it involved removing with a single 16-inch lathe, having two saddles, an average of more than 800 pounds of steel chips in ten hours. In place of the 50-cent rate they had been paid before, they were given 35 cents per piece when they turned them at the speed of 10 per day, and when they produced less than 10 they received only 25 cents per piece.

80. It took considerable trouble to induce the men to turn at this high speed, since they did not at first appreciate that it was the intention of the firm to allow them to earn permanently at the rate of $3.50 per day. But from the day they first turned 10 pieces to the present time, a period of more than ten years, the men who understood their work have scarcely failed a single day to turn at this rate. Throughout that time, until the beginning of the recent fall in the scale of wages throughout the country, the rate was not cut.

81. During the whole period the competitors of the company never succeeded in averaging over half of this production per lathe, although they knew and even saw what was being done at Midvale. They, however, did not allow their men to earn over from $2.00 to $2.50 per day, and so never even approached the maximum output.

82. The following table will show the economy of paying high wages under the differential rate in doing the above job:

Cost of Production per Lathe per Day.

Ordinary Systems of Piece-Work.		Differential Rate System.	
Man's wages	$2.50	Man's wages	$3.50
Machine cost	3.37	Machine cost	3.37
Total cost per day	$5.87	Total cost per day	$6.87
Five Pieces Produced.		Ten Pieces Produced.	
Cost per piece	$1.17	Cost per piece	$0.69

The above result was mostly, though not entirely, due to the differential rate. The superior system of managing all of the small details of the shop counted for considerable.

83. There never has been a strike by men working under differential rates, although these rates have been applied at the Midvale Iron Works for the past ten years, and the steel business has proved during this period the most fruitful field for labor organization and strikes, and this notwithstanding the Midvale Company has never prevented its men from joining any labor organization. All of the best men in the company saw clearly that the success of a labor organization meant the lowering of their wages in order that

the inferior men might earn more, and of course could not be persuaded to join."

This is argument *ad hominem*, not theory, but accomplished fact, and difficult to accept with an inborn idea of "uniform" wages. Here is a well-known industry of great diversity, involving every grade of labor from the highest to the lowest in rank and class, treated upon a method as novel as though it were a problem in mathematics.

Going back now to the beginning of Mr. Taylor's paper, the opening words are:

"The ordinary piece-work system involves a permanent antagonism between employers and men, and a certainty of punishment for each workman who reaches a high rate of efficiency. The demoralizing effect of this system is most serious. Under it even the best workmen are forced continually to act the part of hypocrites to hold their own in the struggle against the encroachments of their employers."

On time or day work we find this:

"10. The simplest of all systems is the 'day-work' plan, in which the employees are divided into certain classes, and a standard rate of wages is paid to each class of men; the laborers all receiving one rate of pay, the machinists all another rate, and the engineers all another, etc. The men are paid according to the position which they fill, and not according to their individual character, energy, skill and profit.

11. The effect of this system is distinctly demoralizing and leveling, even the ambitious men soon conclude that since there is no profit to them in working hard, the best thing for them to do is to work just as little as they can, and still keep their position. And under these conditions the invariable tendency is to drag them all down even below the level of the medium.

12. The proper and legitimate answer to this herding of men together into classes, regardless of personal character and performance, is the formation of the labor union and the strike, either to increase the rate of pay and improve conditions of employment, or to resist the lowering of wages and other encroachments on the part of employers."

Of coöperation, this:

"33. Coöperative experiments have failed, and I think are generally destined to fail for several reasons; the first, and most important of which, is that no form of coöperation has yet been devised in which each individual is allowed free scope for his personal ambition. This always has been, and will remain, a more powerful incentive to exertion than a desire for the general welfare. The few misplaced drones who do the loafing and share equally in

the profits with the rest under coöperation are sure to drag the better men down toward their level."

The gist of Mr. Taylor's proposition is that there should be rates fixed and paid for work on an ascending scale, for shortening time or increasing the quantity, and that these rates under systematic and careful estimating or rating can be extended to nearly every kind of manufacturing operation.

Our conclusion is that the scheme is an original one of much credit to its author, but is an approach through a more difficult road to the "contract system," set forth and explained in an article written by the Editor of "INDUSTRY" for the *American Machinist*, and reprinted in Numbers 78 and 79 of this Magazine for January and February of this year.

No one can dispute the logic and conclusions of Mr. Taylor, but the plan of compensation and the methods of its determination are in a plane too high for common understanding at this day. The rooted customs of ages are hard to alter, especially when each movement is liable to be ascribed to adverse motives, and must run the gauntlet ot suspicion.

TAXES ON SHIPPING IN CALIFORNIA.

It will be remembered that in his report of last year the Hon. Eugene T. Chamberlain, United States Commissioner of Navigation, presented some striking facts in respect to the taxation of merchant vessels in various countries, and in the seaboard States of this country, showing that in a number of cases, especially at this port, the taxes were exorbitant, and operated to drive registry out of the port districts of such States.

This report, which was the first information of the kind given out, has led to the modification of State laws, and a reduction of taxes on shipping in Maine, Minnesota and Wisconsin. In Minnesota the present tax is three cents per ton in lieu of all State and local taxes, and the result will soon be seen in the registry at Duluth of a large amount of lake shipping now documented at other ports.

The flags, British, Hawaiian and others, that we see over shipping sailing out of the port of San Francisco, have an easy explanation in the fact that the sum of $85,675 was assessed here last year on shipping valued at $5,354,675; 1.6 per cent., or more than

ten times the highest amount levied on British and German shipping for the same year. We would respectfully ask our friends if this does not furnish a sufficient explanation of the foreign flags seen around the water front, and constitute a most formidable and unjust discrimination against American property in shipping?

Commissioner Chamberlain has made up a table of tax rates for five of the principal lines in Great Britain and Germany as follows:

Company.	Income Tax.	Tonnage.	Valuation.	Tax in Cents.	
				Per Ton.	Per $1,000
Cunard Co.	$11,304	112,124	$7,927,853	10.	$1.42
Pacific Steam Navigation Co.	2,957	109,059	5,961,888	2.7	0.49
Royal Mail Co.	5,429	80,359	5,583,012	6.7	0.96
North German Lloyd	11,931	211,941	16,395,600	5.6	0.72
Hamburg-American	9,494	170,000	11,255,910	5.5	0.84
	$41,115	683,483	$47,124,263	......	......

In this table the average rate per ton is 6.1 cents, and per $1,000 is 88.6 cents, practically nothing at all if we compare with $86,675, assessed at this port for the same year on $5,354,675 worth of shipping. In the five companies named the sum of $41,115 was collected from an investment of $47,124,263, not one half as much as was paid here on $5,354,675, or roughly the rate here is sixteen times as much. How are American shipowners to compete under these circumstances even if there were not many more discriminations against them?

Mr. G. W. Dickie, of the Union Iron Works, in a recent address before the Manufacturers' Association here, presented this subject of marine taxation in a manner that should enlist vigorous action on the part of that body when the Legislature next meets.

The country members are apt to view marine taxes a good deal as sapient people do the duty on imports, claiming that "the foreigner pays the taxes." Ships are "foreign" to the land people in general, and to the farmers in particular. Vessels sail over the seas, do not use the roads and streets, do not figure in the courts, and are never seen except in the harbors for a portion of the time. The

"granger" sees no relation between these apparently foreign agents and his wheat or fruit crop, and thinks that to tax them is clear gain, lessening his own burthens that much. It is in such a spirit as this that excessive marine taxes are imposed, and a campaign of education is needed in this State.

A NEW EXTRACTING PROCESS.

The *Engineering and Mining Journal* some months ago gave an account of a "capillary electrolytic sluice" that seems to be a novel process in extraction. The following extract conveys the idea of the apparatus, and its method of operating:

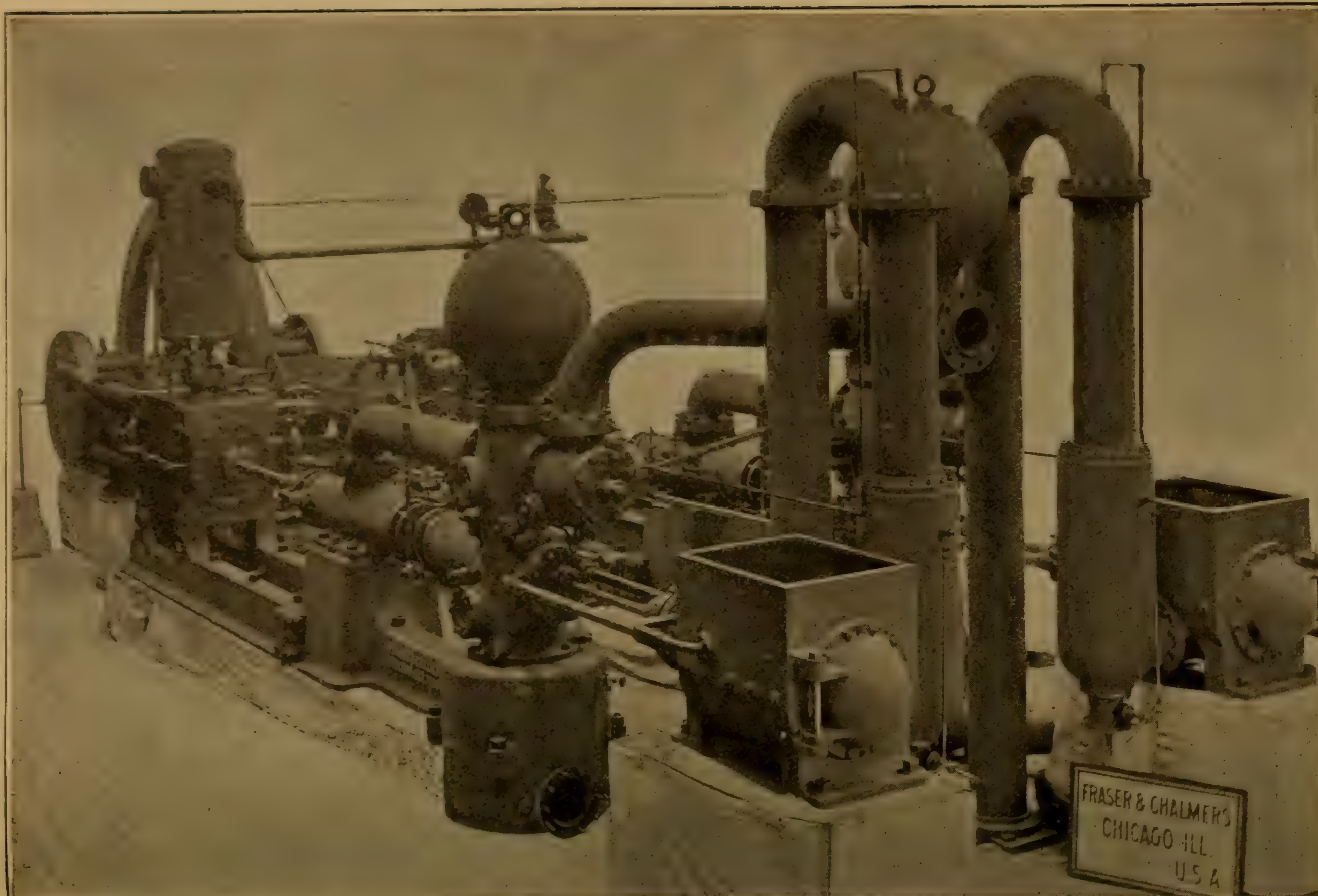
"The capillary-electrolytic sluice, as applied to the extraction of gold, consists of a series of amalgamated copper plates set almost vertically in a sluice box in such a manner that very narrow 'capillary' passages are formed between the plates, flood gates placed at each end preventing the passing of fluids except through these passages, the widths of which are controlled by a hand screw acting on simple adjusting mechanism.

The copper plates used are 12 × 14 inches, with a thickness of ¼ inch, and are 2 inches apart when exactly vertical, when adjusted, however, they incline at an angle of about 45 degrees. A sluice of fifty plates has been found a very convenient size, and a number of such is preferable in large mills to one or two of larger dimensions. The slimes or water carrying the particles of gold flow into the sluice, and after attaining such depths as the capillary passages are adjusted to become exactly equal to the flow into the sluice, and thus an overflow is automatically prevented.

The capillary passages being extremely narrow, about $\frac{1}{50}$ of an inch generally, every particle of metal must of necessity be brought into intimate contact with the amalgamated surfaces, the contiguity of the plates also calling into play the little-considered, but very subtle, molecular force, capillary action, which in this instance acts powerfully in attracting to the plates the metals with which they are in affinity.

The electrolytic action of the sluices is produced by passing a current of electricity through the series of plates, and the flowing fluid passing through the capillary passages between.

The action of the electric current is two-fold: first, in carrying and holding to the plates the particles of the precious metals containded in the flow in a manner analogous to the process of electroplating; and, second, in decomposing the films of oxides or sulphides adhering to the amalgam or to the flowing particles that might otherwise prevent a free amalgamation."



RIEDLER MINE PUMPING ENGINE.—FRASER & CHALMERS, CHICAGO.

RIEDLER MINE PUMPING ENGINE.

FRASER & CHALMERS, CHICAGO, ILL.

The following description of the pumping engine shown on the page opposite, is taking from the *Montana Mining and Market Reporter:*

"The new station pump built by Fraser & Chalmers, for the Butte and Boston Mining Company, of this city, is an engineering design of much significance. It is a duplex pump on the Riedler system, and is to be driven by a compound Corliss engine. The pump plungers are differential, eight and six inches diameter, the stroke being thirty-six inches, and will have a pumping capacity of 1,440,000 gallons per twenty-four hours, against a head of 1,000 feet when running at sixty revolutions per minute. The pumps can be run at ninety revolutions per minute, which will pump 1,300 gallons per minute.

The construction of the entire pump, the pump ends, the body, air vessels, valve chambers, are perfect in design and effect, and the air pumps of Parson's manganese bronze gives a brilliant appearance to the machinery, and makes it rather too handsome to be placed below the ground. Evidently this feature did not enter into the minds of the builders, as the fine finish of all parts is most perfect. The engine, which in its arrangements for convenient handling, and thorough and automatic lubrication, shows more than usual study on the part of the designing engineer.

The illustration which we present, gives an excellent idea of the massive proportions of this extensive plant. Beginning at the steam end, we see a separator for removing entrained water, so that dry steam will be supplied to the engines. The exhaust goes to the inverted **U** from pipes placed between the air pumps which supply the vertical jet condensers, appearing as enlargements of one limb of each of the inverted **U** pipes. Below these condensers are butterfly valves with rods connecting with air valves above them, so that when the pump is stopped, and the butterfly valves are closed, the air valves are, by the same motion, opened, thus destroying the vacuum, and rendering it impossible to flood the steam cylinders.

The differential feature of construction in the pumps gives a double discharge to a single suction, and a greater steadiness of operation. Probably the most important features of the pumps are the Riedler valves, only two large valves to each pump, and not a great nest of troublesome little self-acting valves, but one suction and one discharge, closed by mechanism with precision at the most favorable point for good working, quickly, but gently, and with a provision for elasticity and yield, should hard obstructions get into the pumps. These valves give a good lift, large free passages without slip or throttling of the water, thereby making the service of the pumps

more even and economical. They also permit of high speed, and the advantageous use of engines of the type most economical in the use of steam. The greatest duty obtainable with a giving expense of fuel, is therefore to be expected in this make of pumps. The ordinary mine pump is very wasteful of fuel, and it is a matter of record, vouched for by Superintendent Couch, of the Butte and Boston Company, that the Riedler pumps installed by the company have actually shown a saving as high as sixty per cent. in fuel over that required by pumps previously used.

To express the importance of the Riedler system of pumping, one may get some idea of it by the fact that fifty of the largest cities in continental Europe are using these pumps in preference to others. In the United States the manufacturers have only been engaged for the past two years, but we notice in a catalogue published by Fraser & Chalmers, that a number of plants have been put in some of our largest cities. The usual speeds stated are high, but not maximum, as higher speeds can readily be employed. For pumping, the Riedler system, with its positive closing water valves, secures a singular avoidance of shock, and is found to work with a smoothness and entire security, at speeds which would imperil an ordinary pump."

MANUFACTURES IN CHINA AND JAPAN.

The wily Oriental has been shrewd enough to discern that in certain kind of manufactures, spinning and weaving for example, that heads count instead of efficiency, and he has with haste invited and created such industries in his country, where a redundant population at nearly no wages at all has been turned into factories among the machines to operate in like manner.

This will for a time disturb trade and reduce the sale of American fabrics in Japan and China, where wages are paid in silver, rated at about one half the value it bears here when coined, but the circumstances will no doubt call up other trade quite as profitable.

People who work in cotton factories will soon want bicycles, pistols, watches, wheat bread, and a hundred more things we have to sell, besides, wages will rise very rapidly in Japan, and the difference in rate will grow less.

One Japanese manufacturer, in an address recently delivered in Nagpore, stated that "wages had just doubled since he commenced." This is significant, and should have had notice in Consul General Jernigan's late communication on cotton manufactures in China and Japan. We note also that in reports of the British foreign office that these Japanese factories come up in places "where

there were in former times only unconsidered wastes and squalid hamlets, but now prosperous communities and flourishing towns."

The profits of the business in Japan are too much to remain long undisturbed. Last year eighteen mills in Osaka, Japan, paid an average of 18 per cent., the highest being 28 per cent.

In 1892 this country sent to China about 66 million yards of cotton cloth. In 1893 this fell off to less than 28 millions, which is one of the most remarkable commercial facts of the period, and must have been mainly by reason of the supply coming from Japan, where in 1893 there were forty-six cotton mills with 600,000 spindles. In China too there has been a great increase of mills, which Consul General Jernigan, at Shanghai, estimates at 360,000 spindles, and 3,000 looms in mills now complete and being built.

This branch of manufacturing for the markets of Asia is going to the Orient no doubt, and the fact should be met by our manufacturers, either by doing as the English are, investing in mills there, or in preparing to furnish something else which the Asiatic people cannot make but will want under the changed conditions that will soon come about.

Consul General Jernigan suggests the want of an American serial journal at Shanghai and Yokohama, and it seems a most sensible proposition. The British have been careful to provide press influence, and to this in a great measure can be ascribed their trade ascendency there.

THE MINERAL INDUSTRY OF 1894.

The compilation of the mineral industries for 1894 has been completed by Mr. R. P. Rothwell, the Editor of the *Engineering and Mining Journal*, and is now in press, forming Vol. III of the series, issued by the Scientific Publishing Company, of New York.

Volumes I and II of this important work, comprising over 1,500 pages, have been noticed in these columns at the time of their issue, and have since formed a valuable reference. These reports had for a number of years been issued in a special number of the *Engineering and Mining Journal*, but the more extensive and comprehensive work in this direction, made possible by the census of 1890, led to the preparation of "Mineral Statistics" in volumes as above noted.

Mr. Rothwell having been in charge of this branch under the Census Bureau of 1890 brought to his aid peculiar advantages and

methods, since farther improved by comparisons and the addition of various facts tedious to collect and confirm.

The production of metals for 1894 will be set down as follows, the figures being taken from advance sheets furnished by the Editor of the *Engineering and Mining Journal*:

PRODUCTION OF METALS IN THE UNITED STATES, 1893-94.

Products.	Customary Weights.	1893.		1894.	
		Quantity.	Value at Place of Production.	Quantity.	Value at Place of Production.
Aluminium	Pounds.....	312,000	$202,800	817,600	$490,560
Antimony	Short tons..	350	63,000	220	39,200
Copper	Pounds	327,255,788	35,179,997	353,504,314	33,540,489
Gold	Troy ounces	1,739,323	35,955,000	1,923,619	39,761,205
Iron, pig	Long tons..	7,043,384	93,888,309	6,657,388	71,966,364
Lead, val. N. Y.	Short tons..	166,678	12,434,178	160,867	10,585,048
Nickel, fine.....	Pounds.....	25,893	12,429	....	....
Quicksilver	Flasks, 76½ lbs.	30,164	1,108,527	30,440	1,095,840
Silver, com. val.	Troy ounces	60,500,000	47,311,000	49,846,875	31,403,531
Zinc spelter.....	Short tons..	76,255	6,214,782	74,004	5,209,882
Total metals	....	....	232,371,022	....	194,092,119

The tables sent include all mineral products, but our space does not admit of presenting the whole.

The following excerpt from the remarks by the editor, on silver and gold production, will have especial interest on this Coast:

"The silver production of the United States was maintained at a much higher level than had generally been expected, or than had been predicted by many persons who should be well acquainted with the industry. In 1893 the production was 60,500,000 ounces, a decrease of 4,500,000 ounces from 1892, when it reached its highest level. The low price with which 1894 opened, and the withdrawal of the artificial demand created by the Sherman law, led many persons to believe that the reduction would approximate the amount of the government purchases under that law, or 54,000,000 ounces, which would have been equivalent to practically wiping out the industry. The actual decrease in 1893 was only 10,654,000 ounces, or about 18 per cent. The reduction still leaves the United States

the greatest silver producer in the world, and the industry is, and doubtless will continue to be, a most important one.

Perhaps the most notable feature of the year is the increase in the output of gold. From time to time throughout 1894 the diversion of capital and labor from silver to gold mining has been noted. Not only have many new gold discoveries been recorded, but in many cases also old mines which had been abandoned because they would not pay with the wasteful and defective methods of early days have been reopened with prospects of success under better and more careful methods. The full effect of this revival, however, will not be felt until 1895, and the increase in the gold output has somewhat disappointed the general expectancy, although hardly that of careful observers. The total output of gold in the United States last year was $39,761,000, an increase of $3,806,000 over 1893 and $6,764,000 over 1892. In gold output Australia has also shown a considerable gain, and runs the United States quite closely this year, while the phenomenal increase from the Transvaal mines has also made South Africa a close competitor for the first rank as a producer of the yellow metal."

A NOTABLE AMERICAN ENGINEER.

The *Engineer*, New York, recently reprinted from the *Philadelphia Telegraph*, a most remarkable history of Col. John E. Gowen, that we think should be more widely known, and we reproduce here the main part of the memoir.

Col. Gowen was born in Lynn, Mass., and achieved a reputation as an engineer, perhaps without parallel, in a long roll of Americans who have ventured upon bold innovations:

"In 1856, on the invitation of the Russian government, he proceeded to Moscow to negotiate in regard to raising the Russian fleet, sunk by a hurricane at Sebastopol, which resulted in his being employed to raise the fleet.

This had been repeatedly attempted by English engineers, and much effort and money had been wasted in trying to prove that the performance of the work was impossible. 'No chains could be made strong enough to hold the immense weight of the vessel,' they said. 'If it were attempted to lift them by a single set of chains about the middle they would either be ruined by the severe strain or broken.' And again, 'it is impossible to obtain a lifting power of 5,000 tons,' which is the weight of the largest vessels. Nevertheless Col. Gowen succeeded in raising from the deep twenty-six first-class war vessels, and about one hundred merchantmen and smaller craft. Sixty other boats had been injured by the waves and were removed in pieces.

The way the large vessels were raised was ingenious. Two iron

floating docks, pointed at either end, 60 feet long by 40 feet wide and 15 high, were anchored directly above the sunken ship. They were each divided into 9 water-tight compartments, propelled by 2 screws and supplied with a powerful steam pump. Eight wrought iron chains, each link of which weighed 120 pounds, passed over the sides of each, and under the keel of the sunken vessel. By letting water into the compartments, the docks sunk within 2 feet of the water's edge, and on the water being pumped out rose several feet with the ship. They then slowly steamed toward the shore, and when the ship grounded again sunk into the waves and rose with their burden. This process was repeated until the vessels were high and dry. Every boat raised at Sebastspol was carried in this manner over five miles, and on examination the strain on them was found to be scarcely perceptible, together the docks had a lifting capacity of 10,000 tons.

In 1875, Col. Gowen received a letter from the Brtish Admiralty, inviting his opinion as to feasibility of raising the ironclad '*Vanguard*,' which was sunk by a collision with the '*Iron Duke*' in the British Channel. The English engineers consulted on the subject said that it was impossible to obtain the required lifting power—8,000 tons. As she lay in the path of vessels bound through the channel it was likely that, if she was not removed, some terrible accident would occur from a collision with her hull. Col. Gowen replied that there was no doubt as to the possibility of the achievement, as he had already succeeded in obtaining a lifting capacity of 25,000 tons, and had raised vessels at Sebastopol from a much greater depth in the sea than that at which the '*Vanguard*' lay. He offered to go to England and accomplish the work, and his offer was accepted later in the year.

His plan to raise her, was to use docks of open-truss girder work, each 400 feet long, 100 feet wide, and 30 feet deep, having a lifting capacity of 24,000 tons, and weighing 25,000 tons. The steam pump was to be worked by an engine of 250 horse power, and be capable of emptying the chambers in twenty minutes.

The chains used at Sebastopol were the largest that had ever been made, but those to raise the '*Vanguard*' were to be much larger. Light wrought-iron chains were to be used, each having 150 links, each ling 2 feet long, and weighing 400 pounds. An army of blacksmiths was to construct them in two or three months, and a multitude of divers were to place them under the vessel's keel. During the work 150 men were to be employed on the docks, which were to be so fitted up as to be a very agreeable place of residence. In 48 hours after the docks arrived above the ship she was to be suspended on the chains and immediately brought ashore. The total cost of the operation was estimated at £350,000. The materials in the '*Vanguard*' were said to be worth one quarter of their original value. The vessel was successfully raised, but was never afterward put in commission.

Col. Gowen had had interviews with most of the sovereigns oı Europe, and had received letters of congratulation or thanks from

Queen Victoria, the Duke of Cambridge, Lord John Russel, the Prime Ministers of France, Italy and Turkey, the Russian Grand Duke Constantine, the Grand Duke Michael, and many other notables. On leaving England to prepare his plans for raising the sunken Russian fleet, the British army and navy presented his wife a golden shield, valued at 1,000 guineas, as a testimonial of their appreciation of his disinterested consideration in keeping in repair the cemeteries of the British dead in the Crimea.

From Alexander II., Emperor of Russia, he received the Order of Commander of St. Stanislaus; the Star of the Medjedi from the Sultan of Turkey; Chevalier of St. Maurice and St. Lazare from Victor Emanuel, King of Italy; Chevalier of the Legion d'Honeur from the Emperor Napoleon III., of France. From Queen Victoria he received a valuable gold snuff box, surrounded with diamonds, appropriately inscribed.

ON WAR SHIPS.

Chief Constructor A. W. Stahl, U. S. N., at the November, 1894, meeting of the Society of Naval Architects and Marine Engineers, criticised the automatic machine nature of modern war vessels, especially electrical apparatus, and authoritatively, or at least understandingly, because Constructor Stahl has had a tolerably wide experience, and is professionally qualified to judge of the subject upon which he treated.

"This thing of touching a button, and depending so much on delicate automatic devices, is not what is wanted in a fight," is about the sense conveyed in some of his remarks. The inventors have been at work loading war vessels with ingenious details of one kind or another, until all the accessories of life on land are included. A ship contains about all the elements of a hotel, a city, and a factory; electric, hydraulic, pneumatic, steam and other apparatus; disposed, dependent and interwoven, one thing with the other, so it may be said that the integrity of the whole is dependent on each part or department, until, as Constructor Stahl remarked, the human machine is nearly eliminated.

An engineer or mechanic capable of receiving a rational impression, will on going over a modern war vessel conclude that it is near impossible to maintain all this apparatus, even when a vessel is in dock or moored, let alone in a battle.

The subject of Constructor Stahl's paper was "Hydraulic Power for War Ships," with especial reference to the equipment of the

Olympia, built under his supervision as Government constructor, here at San Francisco. In the discussion that followed, it was easy to see the animus of the Cramp combination that attacked the plan of hydraulic steering gearing, because of its want of functions, which they have evidently not succeeded in attaining in their own practice.

Mr. Williamson, of Philadelphia, who it seems, makes auxiliary engines for the Cramp Company, set up the claim that hydraulic gearing for steering was not precise enough, or too precise, we can not determine which, but that it caused "yawing" of a vessel. This is a most extraordinary claim, because the main quality in hydraulic movements is the absolute action, which cannot well be separated from precision, and if "yawing" by reason of rudder action is to occur the most likely way to produce this would be to employ an elastic medium for transmission.

There was the usual hit at the British, who Mr. E. S. Cramp considered did not have the "adaptability to adopt" friction gearing for winches, and used noisy hoisting engines that "tore the deck to pieces," because they were geared with "cog wheels." This perhaps needs no comment. A friction geared winch is not the equivalent of a positively geared one, therefore not directly comparable, besides the gearing is not what "tears the deck to pieces," and is commonly noiseless when well made, as it nearly always is in England.

We would not consider it proper to thus comment on the remarks of those representing the Cramp Company, if it were not that in almost every paragraph that has ever appeared from that company, there is disparagement of some one or of some work done by others. If there is more than commercial aggregation to rest their extravagant claims upon it has not appeared; not only this, the studied suppression of the fact they have from the beginning drawn upon the skill of other builders, as in the case of the *St. Louis* and *St. Paul*, that were redesigned by Dr. Elgar, who came out from Glasgow for that purpose.

Constructor Stahl, in his paper, as becomes technical works of the kind, avoided invidious comparisons, and the weak bolstering of particular facts, which seemed the stock in trade of his critics. Facts, when proved and explained, as were those set forth in the paper, are not fairly met by what "we did," "look at us" and see what "some one said." It is a boyish kind of argument, and incompetent in the technical treatment of a subject like that of Constructor Stahl's paper.

LITERATURE.

The Engineering Magazine, July 1895.

The present is a special issue of this important magazine, devoted to railways in the United States, embellished with a large number of fine plates and illustrations explanatory and descriptive of our greatest internal industry.

The number contains about twice the usual amount of matter, and is indicative of a prosperous condition of the magazine. This cursory mention precedes reading the number, and further notice of the contents will appear in this department.

The Technology Quarterly, Dec. 1894.

Most interesting among the articles presented in the present number of the *Quarterly* is a record of "Summer Instruction" at the Massachusetts Institute of Technology. During the summer months the students go out to perform actual work of various kinds, and sometimes, it seems, to venture upon extensive and intricate undertakings.

In the present number is a large map, surveyed over the land and property of the Dominion Coal Company at Cape Breton, Nova Scotia. This work was accomplished in three weeks by twelve of the students of the School of Mines, and is certainly a remarkable work to be thus carried out. The area included is immense, and the vertical components, to so call them, of coal and other strata some thousands of feet in depth.

The proceedings of the Society of Arts, an institution meeting semi-monthly under the control of the Institute of Technology, occupy the first portion of the present number, followed by the usual technical papers of originality and merit.

Cassier's Magazine, July 1895.

NIAGARA POWER NUMBER.

This extraordinary issue of "Cassier's" is so far as we know, without a parallel, in industrial literature at least, and there is some doubt as to even this qualification.

The regular text of 210 pages is supplemented with at least 100 more of reading matter, so the issue may be called one of 300 pages. A commendable modesty has prevented the usual "sign-board" matter, and happily, perhaps, left us without the usual statistics of making up such a number. The expense must have been very great.

We cannot enter upon any notice of the subject matter, prepared by ten different contributors, most of them past or present officers of the Cataract Construction Company, mainly engineers and scientific men who have participated in the great work. The present number should be bound in a volume by itself, and preserved as a complete history and description of this greatest work of the kind attempted to this time.

The Electrical Journal.

No. 1, Vol. 1, July 1895.

The advent of a serial devoted to electrical matters and interests is not an unexpected circumstance in San Francisco. Trade, scissors and paste have their necessary place in the make-up of serial literature on this Coast, removed as it is some thousands of miles from other fields of like activity, but there should be other components in respectable make-up, and these are conspicuous in the present issue of the *Electrical Journal*.

We welcome our contemporary as an example of "honest goods" provided out of investment and work, and trust that the standard here set up will be maintained.

The subscription rate is $1.00 a year, and the publication office at 303 California Street, in this City.

Prospecting for Gold and Silver.

BY PROF. ARTHUR LAKES.

The Colliery Engineer Company, Scranton, Pa., have issued a neat well-bound little volume under the above title, containing Professor Lake's contributions to the *Colliery Engineer* on the subject of mining for

gold and silver. We can hardly say "prospecting, because the aims and attainments of the volume are much wider than the title indicates.

Professor Lakes, of Colorado, late Professor of Geology in the State School of Mines in that State, has produced here an intensely practical treatise of 202 pages, and nearly a hundred drawings, that is best described in the following words from the publishers' prospectus:

"The prospector and the miner need to combine theory with practice. An 'old-time' prospector has generally plenty of practical experience and very little theory. The novice goes into the field armed with his college experience and book theory, and has all to learn in the way of practice. Combine these two characters in one and we have an ideal prospector. This book is intended to do this."

The price is $1.00, post paid, and might be three times as much and very cheap at that.

The Journal of Zoöphily.

This publication, under the strange name above, meaning the love of animals, well printed on good paper, sincere and sensible, comes as an opponent of vivisection and other cruelties to animals.

Our notice must be confined to the story of remembrance running back to small boyhood, when a Scotch mother said: "Lad, look out for people who are kind to animals, birds and insects, make friends of them. They are sound folks always." This was never forgotten, and if there is any single gauge of human character to be relied upon that one is indicated in this rule.

Sir Charles Bell, of the Royal College of Surgeons, said:

"Experiments have never been the means of discovery, and a survey of what has been attempted of late years in physiology will prove that the opening of living animals has done more to perpetuate error than to confirm the just views taken from the study of anatomy and the natural motions."

SIR CHARLES BELL, F. R. C. S.

Electric Power Magazine.

This publication, after a period of change all the time toward more completeness, has now taken the form of original essays on electric subjects by competent writers, and will no doubt have a permanent place in what may be called the electrical literature of our time.

One must, however, regret the title of "*Electric Power*," which in its true meaning does not fit the subject matter here. There is no such a thing as electric power at this time, in the sense of electricity being a primal source of energy. Its function in the field of dynamics is purely that of transmission. It corresponds to ropes, shafts and fluids as a medium of conveying and translating power or work, so the term "transmission" seems wanting in the title.

The "make-up" is complete, and includes a very useful synopsis of current corelated literature. The magazine is published at 27 Thames Street, New York, at $2.00 a year.

Messrs. D. Van Nostrand & Co., of 23 Murray Street, New York, have issued recently a very complete catalogue of books on steam engines, machinery, mechanics, etc., that embraces all the principal and latest works on these subjects. As these catalogues are sent on application from those interested in such literature, our suggestion is "send for one."

The *Industrial Reporter*, Denver, Col., has issued a very remarkable number of their journal, showing in extensive plates prominent works of interest in Colorado and about Denver, some of which will astonish even those of neighboring States. The Colorado Fuel and Iron Company's Works for one, covers 100 acres of ground, produces 500 tons of steel ingots and 400 tons of railway bars daily.

Among all cities of Western America, Denver has been the most successful in development. Surrounded on all sides by a speculative environment the city itself has "kept cool," kept out of debt compared to others, been internally developed, and at the same time identified with all the varied interests throughout the State. The *Reporter's* present number is a great credit to the publishers. Price 25 cents.

The space for book reviews has this month been in part taken up by other matter, and a number of notices are consequently laid over for another issue.

LOCAL NOTES.

The Southern Pacific Company have discovered that they can operate one long heavy train cheaper than two or three lighter ones, and consequently are arranging their traffic this way without regard to public convenience. Imagine one going up to Byron for example, in a train of twenty or more cars, at the rate of sixteen miles an hour. The idea seems to be, and the fact is nearly the same, to run one train a day on the various diverging lines, and if the traffic was small no one could reasonably object, but when it comes to compressing the traffic of a whole day into one train that ought to be divided into three, and then hauling this enormous load at the speed of freight service, it is not fair towards the public. If the traffic did not pay it would be different, but everyone knows that the local service will pay well with lighter and more frequent trains.

The Manufacturers Association are not discouraged by the fact that there seems to be no defined line of action, but are proceeding in every way that opens, to excite attention and make opinions. Already a good deal has been accomplished in the way of both actual work and in creating investigation. The difference between purchasing here and at the East can not in the nature of things be much, and a very little may influence a larger trade in home produced commodities. Whatever is done now it must be remembered is tentative. It is like beginning a drawing on a clean sheet. The design and ultimate design must grow out of the work as it goes along. In another year methods will be more clear, and the influence of the Association wider, especially if the local manufacturers second the efforts made by maintaining good faith with consumers. One faulty overcharge or faulty fulfillment of an obligation, puts a strong weapon in the hands of competitors, to be turned against the Association and local producers.

We are informed that Professor George Davidson has decided to act in the capacity of a consulting engineer in works for irrigation, the conservation of water, hydraulic work, and in any public or private works of an engineering nature. While admitting his

high professional abilities and the commissions he will undoubtedly receive, we must contend that his services should revert now to the State of his adoption, and where he has labored for fifty years. His "*Coast Pilot*" should alone earn him a munificent revenue, but like all officers of his standing in what may be called the technical bureaus of the Government, his whole work has, without regard to his own interests, been turned into the account and use of the General Government, so also his meager salary has been absorbed to a great extent in the implements and aids to his work, happily to remain in his own hands however. Professor Davidson, while an officer of the Government, was frequently impressed into private service, now he is free to exercise his profession.

Captain Matthew Turner, of 40 California Street, the owner of the ship-building yard at Benicia, has been importing from Tahita, a peculiar kind of wood called *Purau*, that he has used to a considerable extent in the construction of yachts. The wood, of which Captain Turner has sent some examples, is among timber, what aluminium is in metals, possessed of a strength far exceeding what its weight indicates. Its growth is remarkable. The first year it resembles a pithy vegetable, no heavier than cork bark, but each year after becomes tougher and harder, until at its maturity it is like teakwood. In the yacht *Folly*, built here some years ago by the Davidson Bros., *Purau* wood was used for her frames, with the result that the displacement was nine, instead of ten tons that it would have been if native timber had been used. Examples of this curious wood can be seen at this office or Captain Turner's.

The Supervisors of Marin Co., recently met to confer with the State Commissioners of Roads, and learned from this latter body, that the bridges should be made of stone and the roads sprinkled twice a day. This is important. There should also be masonry parapets built outside the roadways on all mountain grades, with many other things that can be learned out of books. If the Road Commission had gone to San Rafael over the main road leading there from this City, they could have offered some opinion respecting a road seven feet wide over the spur that divides Richardson's Bay from Corte Madera, a road that does not permit two vehicles to pass, except at a few dangerous points. They might also have discovered that the quality of the roads was dependent on the distance from San Rafael, with a good deal more that is not set down in books.

Mr. G. W. Dickie, of the Union Iron Works, has furnished for the *Traveler* a popular description of the hydraulic dock at these works, the most notable one of the kind that exists in any country at this time. This dock is an immense platform, 62 × 435 feet, raised by hydraulic rams up level with the yard, so that a ship when docked is in the same condition as if lifted up and set in the works, accessible all around and at the working level. The "overtake" controlling gearing, that produces coincident and uniform action of the thirty-six hydraulic rams, is a novel and ingenious feature, the one that renders the system possible. The construction of such a work in "mud" eighty feet deep, that has stood for eight years and raised vessels to the amount of more than one million tons without accident, is an engineering feat with few if any parallels. The dockage amounts to about 125 ships a year, and the total of weight raised on it was at the end of April last 1,071,934 tons.

The expediency, and even the necessity of selling American products of various kinds abroad, is now conceded by nearly every one of our exchanges that come to hand, and while it may do no good to point out that all such trade will be strangled by the "marking up" process now going on, it can do no harm to remind people that in a "resumption" of business an over anxiety to increase profits will check the progress. The price of all kinds of goods and commodities is based on the cost of their production, and while in a good many cases the margin of profit has disappeared, this is not true of all, perhaps not of many things, and it is better to "go slow" for a time, until there is normal demand and the wave of new confidence has fully reached this Coast. It is always some months behind the Eastern States, and goods held here on consignment are apt to be marked up before local circumstances warrant an advance.

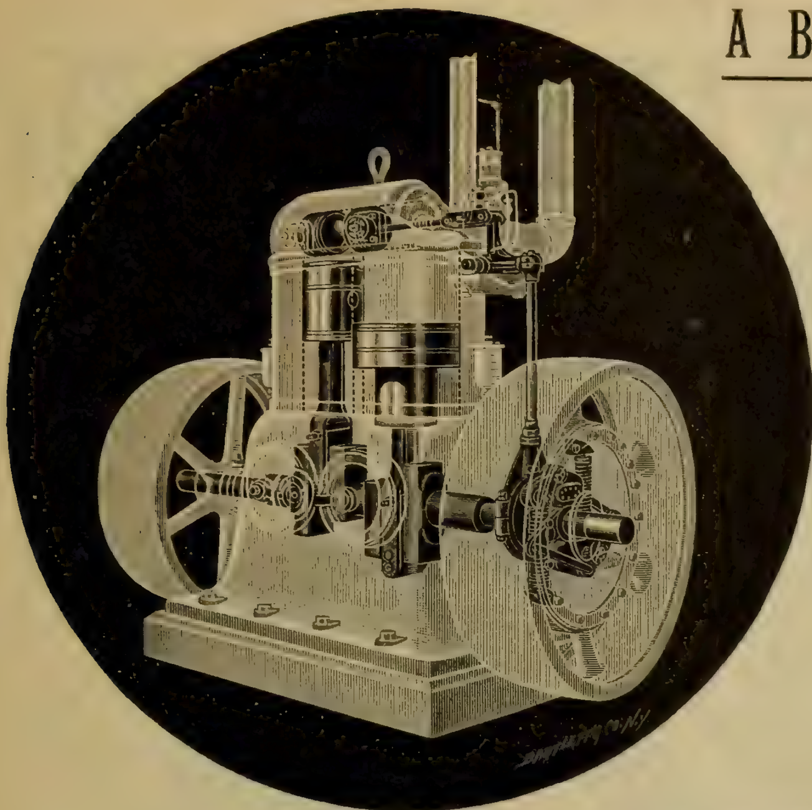
According to a reported computation and opinion of a manager of one of the Chinese companies at Seattle, Washington, wheat flour at 1½ cents a pound will displace rice as an article of diet among the Chinese. There is, however, a serious doubt cast upon this opinion by an assumption that back cargoes of rice can be sent here at half a cent a pound. This latter may be a mistake, because rice cannot well be furnished at such a price, and if it could is a cheaper food than wheat flour at 1½ cents a pound. The

investigations were made by "Jim Hill," and have a significance, because if he finds the wheat of the high North-West can be profitably sent to China he will do it in a business manner, and keep on doing it. No commercial fact was ever more clear than that the wheat of America must be got into Asia. The European market is becoming less all the time, and the causes are permanent.

The Abner Doble Company, of this City, as agents of the Walker Manufacturing Company, of Cleveland, Ohio, will furnish the electric motors for the Sutro City and Ocean Railway. The equipment is peculiar. Fifteen cars are provided with 100 horse power each, divided between two motors. These cars weigh ten tons and will accommodate 180 passengers each, and haul a "trailer" of five tons with 120 passengers, making the load 300 people for each motor car. The maximum grades are 11 per cent. and are to be ascended at five miles an hour, so the provision of 100 horse power for each train is no more than is required. This will be in some respects the most extensive application of electric driving for suburban railways, and is certainly so on this Coast. It will also be the first electrical equipment from the Walker Manufacturing Company sent here. The Fulton Engineering and Shipbuilding Company will make the motive engines, and the line will be ready for service in the early autumn.

COMMENTS.

The *Indian Textile Journal*, for May of this year, comes to hand with a worthy comment on the recently proposed law in Germany to prevent deceit and false statements in trading, admitting however the good effect of such a law if it can be enforced. The article is headed "Morality by Act of Parliament," which, in view of the policy of the British Government in respect to trade, comes very near describing the acceptance of the idea in Her Majesty's dominions, and in a sense in which we must concur, but there is another way of looking at the matter. A proper function of all governments, and evidenced in the laws of all countries, is the protection of people against fraudulent practices, but such regulations become very weak in respect to trade for fear of curbing thrift. The German Government is right, and if they have the power



A BUSINESS PROPOSITION!

☞Any purchaser, so desiring, is welcome to have his engine tested by his own expert at our shops before shipment, and may accept or reject the engine on that test before incurring the expense of installation.

THE WESTINGHOUSE
THREE ENGINE TYPES

COMPOUND 5 to 1,000 H. P.	Unequaled simplicity, high efficiency and moderate cost.
STANDARD 5 to 250 H. P.	A high-class automatic, endorsed by thousands of users.
JUNIOR 5 to 75 H. P.	A durable and efficient Automatic Engine at a low price.

Catalogue on Application.

THE WESTINGHOUSE MACHINE CO.

PITTSBURGH, PA., U. S. A.

☞SELLING OFFICES.—26 Cortlandt St., New York, N. Y. 171 La Salle St., Chicago, Ill. 53 State Street, Boston, Mass. Westinghouse Building, Pittsburgh, Pa. 210 Drexel Building, Philadelphia, Pa. 37 College St., Charlotte, N. C. 21-23 Fremont St., San Francisco, Cal. 259 Main Street, Salt Lake City, Utah. Wonderly Building, Grand Rapids, Mich. All Offices of the Westinghouse Electric and Mfg. Co., and all Foreign Countries.

BERLIN LONDON ST. PETERSBERG VIENNA

Siemens & Halske Electric Co.

Pacific Coast District, 508 California St., S. F. **Head Office, Chicago, Ill.**

Yard Telephone No. 67 **Office Telephone No. 5153**

CALIFORNIA
IRON and WRECKING CO.

Successors to HENRY J. ROGERS & CO.

Submarine Contractors, Wreckers and Divers

IMPORTERS AND WHOLESALE DEALERS IN

CAST AND WROUGHT IRON

IRON SCRAP, and other METALS,

Second-Hand Machinery and Water Pipe,

Iron for Smelting and Reduction Works

638-640 Second St., San Francisco

to prevent "Peter Funk" methods by law so much the better for Germany. The British small tradesman has by a proverbial cunning wormed himself out of the meshes of the law, and our own are close behind him. Whether law, or other remedy, is wanting we cannot say, but the credulity of people should make us ashamed of our time.

In connection with the above, and the marked credulity of people who have a high reputation for common sense, we find in the prospectus of a new company, who are to controvert certain well-known physical laws and make the shareholders rich, the following:

"There are signs in the air that the long-suffering and patience of the American people are at end, that financial agents will be held to a strict account, and that the power of law will be invoked to protect the investor and punish the thieves, even in high places, who have brought loss and desolation to so many, and has lowered our national good name so much that in Europe but little confidence is placed even in industrial schemes, through the manipulations of financial rogues and rascals."

This is "stealing the livery of heaven to serve the devil in." We do not want to indulge in an assumption of prescience, but must remind the readers of "INDUSTRY" that for seven years past they have had no excuse for losing their money in schemes involving manufactures and the like, each one of a prominent nature has been "forecast" in these pages. The record is "printed," and if mistakes have been made we do not remember them.

Mr. Hiram Maxim does not intend to leave this world until he has made the way easy for his fellowmen to follow. The principal object of his flying machine, as he stated, would be to drop nitro-glycerine on an enemy, and that such a machine would enable one nation to destroy another. His present business is making implements for quick destruction, maiming and killing men, in which business he seems to find a grim satisfaction. The latest horror proposed is a portable mitrailleuse to be carried by a soldier, capable of killing people half a mile away with shots fired at the rate of 500 a minute, or in case of a hurry 700 a minute, so that one man and one gun can "mow down" (*sic.*) a regiment of men in one minute. It is all very ingenious, no doubt, but as it is commonly assumed that only one side is to be armed with such implements, would it

not be better to poison the water, or scatter cholera germs among the enemy? It is a shame that skill like that of Mr. Maxim should be spent on such ignoble work.

We have many times written skeptically in respect to "whale-back" steamers on this Coast, with strong doubts as to other places, and now find warrant in such an opinion by the withdrawal of the second one from the upper coast coal trade. The difficulty of trimming a cargo to fit the curved decks is assigned as one reason by the *News Advertiser*, of Vancouver, B. C., which says the *City of Everett* is for sale. The first of these porcine-modeled boats, the *Wetmore*, hammered herself to pieces, as our readers will remember. The new type, called "turret ships," on the barge principle, are now to be tried on the coal trade. The *Progressist*, that recently came out from Sunderland, England, and was described in the newspapers, is now on trial, and is certainly an improvement in so far as she is more like a ship, and we suspect this qualification applies to the whole whale-back tribe for ocean service. They are better or worse in the same degree that they approximate what half a century of experience has pointed out as an iron "ship."

We have recently received a slip of set matter issued by the Inter-State Commerce Commission for the use of the press, and so far as appears the business of the Commission is the collection and publication of railway statistics, work that if done at all by the Government should, as in France, be taxed upon the railways themselves. If the Bureau has other functions than collating reports, mileage, classification, equipment, and so on, that is, if there has been administrative acts, decisions, or other things done to regulate commerce in the interests of the country and people, we would willingly devote space to publishing accounts of the same, but the present statistics have no interest to our readers, except that of curiosity, and the subject matter is available in other ways than through the Commission. The law creating the Commission, and to regulate commerce between the States, has been, as we believe, quite barren of any result, and is likely to be barren as the law has been interpreted by the courts.

When a firm or company carries on some manufacture so extensively as to give them a practical monopoly of a product, patents are

of little use to them, and this we fear has a good deal to do with the Carnegie Company, at Pittsburgh, disputing the validity of the nickel-steel patent, and the Bethlehem Company taking a similar course in respect to the Harvey patent on surface-hardened armor plates. Both these companies have been furnishing the Government with plates made under these inventions, as it is alleged in the Carnegie case at an advance of two cents a pound to cover patent royalties. It is also asserted in a complaint filed in the United States Circuit Court, at Pittsburgh, that Mr. Carnegie negotiated with the nickle-steel company, at London, for the use of the invention in the United States at the rate above named. Now it is contended that the patent is invalid, because an alloy cannot be patented in this country, and because the nickel alloy was known and described anterior to the Schneider patent.

ENGINEERING NOTES.

In some remarks made by M. Geyelin, before the Engineers' Club of Philadelphia, he explains that he was the designer of a pair of turbine water wheels sent to Mexico in 1854, to operate under a head of 160 feet. We have been aware for many years past of these wheels being made at an early date, but did not know that they emanated from Mr. Geyelin. These were perhaps the first pair ever made and mounted oppositely on a horizontal axis, so as to balance the thrust each way. The firm to whom the wheels were furnished at Palitas, Mexico, intended to have made in England an overshot wheel at a cost of $25,000, but was persuaded to use the turbines at a cost of $2,300, which gave complete satisfaction, and several others of the kind were afterwards furnished. M. Geyelin was acquainted with both Fourneyron and Jonval, to whom the world is indebted, not only for the most important types of the turbine, but, as we may say, for the turbine itself.

There appeared in *Engineering*, London, No. 1,538, a communication from Mr. J. E. Johnson, of Longdale, in Virginia, on the subject of "Governing Engines, or on Governing Apparatus for Engines," that we would like to republish, but space prevents, and we can only say that while the propositions laid down are wide of common opinion they seem to be substantially correct. One assumption is

that the inertia element in engine governors does not as a rule lead to more efficient action or sensitiveness, as it is called. The writer is evidently very familiar with the subject, and gave a first place to the governor invented by Prof. John E. Sweet, which we think maintainable, because it has been widely copied, made under royalty and infringed upon. This governor has but one weight, a deflecting spring, and in all about one half the pieces common in apparatus of the kind. Prof. Sweet himself in a recent lecture has taken nearly the same view as that advanced by Mr. Johnson in respect to inertia governors.

In a letter received from Lieutenant-General Altfater, of the Russian Army, St. Petersburg, Russia, he says of a paper on "Impulse Motive Engines," read before the Technical Society of the Pacific Coast by the Editor of "INDUSTRY," and published in the Magazine, No. 79, for February last:

"I can fully agree with you in respect to the great importance of this evolution now going on in the direct application of the velocity of steam as a motive element. The sole object of the receptor or motive engine is to operate as a transmitting link, or as a transformer of kinetic energy, $\frac{m\ v^2}{2}$ of the steam to its equal (taking no account of losses) amount of kinetic work. At present this link is the reciprocating piston apparatus with limited speed, operating in a series of waves, with limitations of speed, weight, space, joints, strains and vibration. On the other hand in de Laval's engine there is a continual efflux of steam, the whole of its kinetic energy imparted to a rotating wheel. Seeing a de Laval engine of 15 horse power, weighing only 600 pounds, standing on a common wooden table, working gently without noise or vibration, I felt at once, this is the natural method of employing steam as a motive agent."

In the *Electrical Journal*, for July, is a plate showing the generators, engines and dynamos provided by the Union Iron Works for the United States Cruiser *Olympia*, built at these works, which for symmetry and completeness in all details are not we think exceeded, unless by later machines made at these same works from like general designs. The making of these independent steam generators has in a sense become an objective point in emulative design, especially for marine uses, and is in England almost an exclusive branch with certain firms, hence such machines are closely scrutinized by mechanical engineers as a kind of test of designing skill. The type is naturally

uniform in a degree, and the workmanship and performance more uniform, no doubt, but there is a "dress" or impression, it may be called, not translatable into words, that forms to the skilled critic a gauge of excellence in an engineering way that is usually correct and reliable.

The de Laval impulse engine is making way in France. During twelve months past the French company have built thirty-nine plants for electrical work fitted with the turbines, some of them being of 300 horse power. From a private letter we learn that a good many of the flexible spindles on which the wheels are mounted, break, and this is not to be wondered at. This is a fad, we may call it, of the inventor, and we think of no importance whatever, because other more durable mechanical expedients will answer the same purpose. It is nearly impossible to perfectly balance a body to run at a rate of ten to fifteen thousand revolutions per minute, and the Doctor mounts his wheels on slim shafts that will bend, and thus permit the wheel, like a spinning top, to assume a theoretical center of gyration. Any kind of yielding support will do this. An engine or wheel made here by Mr. W. A. Doble was fixed on an overhanging shaft, which is in effect the same thing, but the true way seems to be in providing a movable bearing, as in the case of centrifugal extractors.

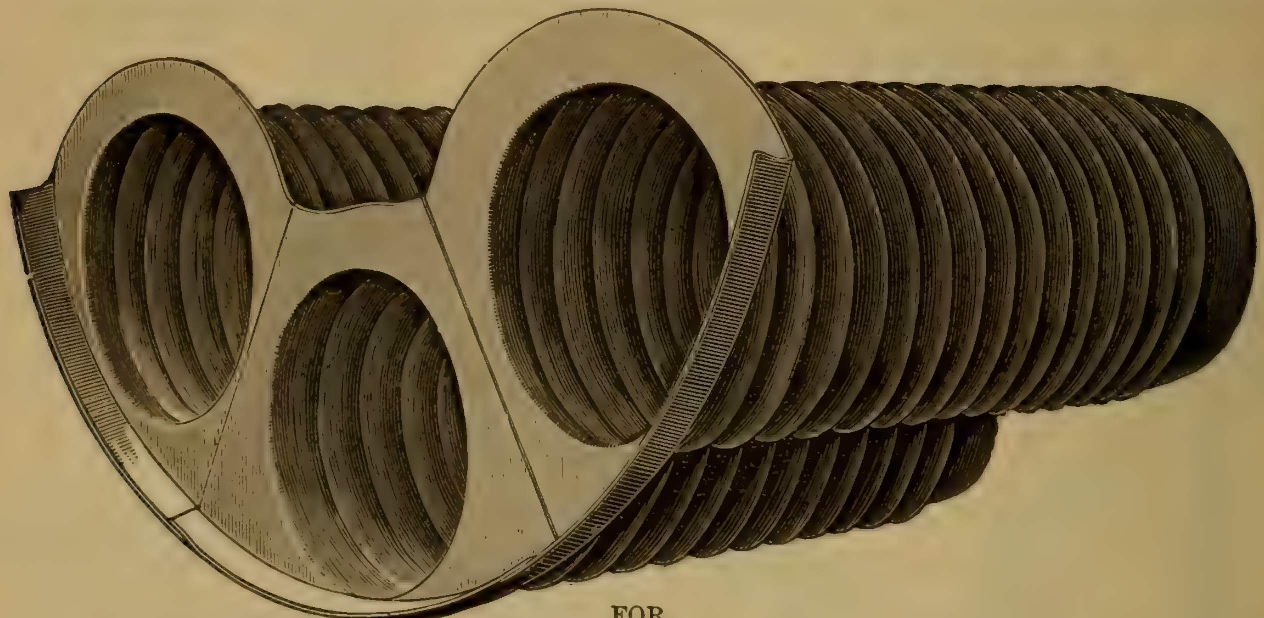
Scientific men and others in this country who have disputed the phenomenon commonly called crystallization of metal under blows or changing strain, as in Howe's *Metallurgy of Steel*, and Dr. Raymond in the discussion of Mr. Rickard's paper on "Stamp Milling," at Chicago last year, may quibble about the meaning of terms and molecular change, but we think since the publication of Prof. Autenheimer's monograph on this subject they will have a "job on hand." When any property of material like that known as crystallization has been observed by practical men for ages past, and acted upon in practice, there is little use of any one scientifically or otherwise disputing the fact. A laboratory is not always the place to determine such things, and even in practice one must concede the complexity of this matter, unless, as we strongly suspect, Professor Autenheimer's propositions and formulæ cover the case. An engine connecting rod may act 25 million times and not break, as has been shown, but the bolts that hold the dies on trip-hammer helves do break with a regularity well understood. A hammer can be worn

down to the eye and not break, so other forms of metal disposed in a ring, but stamp stems break, so do other things having a neutral axis, and subjected to "reversing strain," as Prof. Autenheimer calls it.

Prof. Autenheimer's investigations, supported by facts as well as his ingenious formulæ point to a "change of stress" as the disrupting cause in the fracture of metal parts of machines. *Spannungswechsel* is the term he employs, which can be translated "change of strain," and includes stress in opposite directions, bending two ways it might be called, and this is precisely what occurs in cases where "crystallization" takes place. For example, the bolts to hold hammering dies are strained in one direction, except at the instant a blow is struck, when the strain is suddenly neutralized or reversed, so with stamp stems just above the shoes, the crank end of engine shafts, and the overhung end of railway axles. We once had occasion to cut off the outboard bearings of an old railway truck, and make new ones inside of the wheels; one of the ends was hacked around with a chisel, and then knocked off with a light blow. The man who did the work was astonished, and struck the next end without using the chisel; that dropped off, and he went to the other side, knocked off the other two with a single blow on each.

The Westinghouse Machine Co., say that when the committee of a prominent engineering organization sent letters to various engine makers asking for data concerning steam economy under various specified conditions of service, that the Westinghouse Company alone answered the inquiry in full, all others evading the matter, except one who admitted "he did not know." This is a very creditable circumstance for the Westinghouse Company, who we suspect was almost alone in having ready the required information. It may be said that makers of steam engines have never been called upon to guarantee efficiency under variable loads, but this is an accident. An engine made or sold for a specific duty should be judged in respect to that duty, or we might even say at this day nearly all engines should be rated for efficiency under a varying load. The point is important, and was long ago gone into by the Westinghouse Company, who had prepared by experiments the adaptation of their engines as far as possible to irregular work.

CORRUGATED FURNACES



FOR

MARINE and LAND BOILERS

ALSO

MORISON SUSPENSION FURNACES

SOLE MANUFACTURERS IN THE UNITED STATES

THE CONTINENTAL IRON WORKS

BROOKLYN, NEW YORK

THOS. F. ROWLAND, President
THOS. F. ROWLAND, Jr., Treasurer

WARREN E. HILL, } Vice-Presidents
CHAS. H. CORBETT, }

Take East 10th or 23d Street Ferries from New York to Greenpoint.

INCORPORATED 1866

Insures against Damage to Property, Loss of Life, and Personal Injury

CAUSED BY

STEAM BOILER EXPLOSIONS

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD
CONN.

CHARTER PERPETUAL

J. B. PIERCE, Secretary

J. M. ALLEN, President

ABSTRACT OF STATEMENT
JAN. 1, 1895

Cash Capital,	**$500,000.00**
Total Assets,	**1,955,255.24**
Surplus as to Policy-Holders,	**693,726.15**

PACIFIC COAST DEPARTMENT

MANN & WILSON, General Agents

J. B. WARNER, Chief Inspector

306 Sansome Street - San Francisco, Cal.

The first complete "suction" dredging vessel built in this country on the hopper and self-propelled system has been constructed at New York by a Milwaukee company for the Government, to be employed at Galveston Harbor. There are two centrifugal pumps, which according to the description are to raise 600 cubic yards of sand per hour, but how this estimate is arrived at we do not know. The vessel is described as a complete ocean-going steamship of 500 horse power, to go at 10 knots an hour, provided with search lights and all required accessories for the work of sand dredging, such as has been done in the Mersey, at Liverpool, and various other ports. The data and precedents for such dredging vessels is quite complete now, and we imagine that good results will be achieved, and hope the work at Galveston will accomplish more than has been previously gained by a great deal of expenditure there. The tidal flow, outward and inward, is practically equal, and is very unlike the circumstances at New Orleans, where the river scour prevents the back-wash of sand.

"Techno" this month, discourses concerning balancing mandrels or spindles, and describes how there is no need of such mandrels fitting or filling the holes in wheels or pulleys. This is an important matter, that will save ten times the price of "INDUSTRY" in any machine shop each year, if it is as described. Mr. E. S. Cobb, a skilled mechanical engineer, formerly of the Rose Polytechnic Institute, at Terre Haute, Indiana, now of this City, says the method is all right, and he has employed it, also has instructed others in the matter. It will be a favor if any one of our readers who try this method will send in the result, and credit Mr. Cobb, "Techno" or "INDUSTRY" with the saving of expense for a year, or any longer period. Also if it is wrong and "won't work," send the reason why. There is no doubt the difference between a circular body rolling on a flat plane, and one rolling in a curved seat, but this cannot amount to much.

Some years ago we published a discription of the "plansifter," a German invention for bolting flour, consisting of a gyrating sieve that brought the acting surfaces into nearly constant use, consequently had in proportion to the area of cloth, greater capacity with other claimed advantages that seemed logical. On showing the matter

to a well-known millman here he pronounced it a "humbug," of no use whatever. This view we did not accept, and in warrant now find that Mr. Charles A. Pillsbury, of Minneapolis, manager of the Pillsbury–Washburn Mills there, has adopted the plansifter method of bolting, and has in these great mills 125 machines in use. He says there is a great saving of room and power with better work than the reels performed. The Pillsbury–Washburn Mills are the largest in the world, and no doubt among the most intelligently managed.

It is curious these times what a little thing in constructive mechanics furnishes material for an all-around article. A new toggle-geared air compressor has come up in numerous journals, home and foreign, during the last month, and has, it is true, some "geometrical" interest, and little more. It is made by the New York Air Brake Co., and is to utilize or adapt the resistance of air-compressing pistons to the working steam piston, the same as a Davy pumping engine fits the expanding steam diagram to a constant water-moving piston, only it has the difference of fourteen pin joints in the gearing against four in the Davy motion and some others that might be devised. The scheme will furnish the usual interest to students and others who have not had much experience with "chewing joints," as they are sometimes called, in machinery.

Electricity.

The Secretary of the American Institute of Electrical Engineers, Ralph A. Pope, E. E., has courteously sent advance slips of two of the papers presented and read at the Niagara Falls meeting of the Institute, in June of this year. One by Mr. G. H. Wilson, on the Long Distance Electric Transmission Plant at Pomona, Cal., and the other new paper by Dr. C. E. Emery, on the Cost of Steam Power. Both of these papers are of much interest. The San Antonio Company have available nearly 1,900 horse power, which is transmitted by electric lines to Pomona, 13¾ miles, and to San Bernardino, 28¾ miles, and applied to lighting purposes. The power is derived from the San Antonio Creek, under an effective fall of 390 feet, through a pipe 30 inches in diameter, 2,730 feet long, made of steel plates riveted. The electrical section of this paper is very

comprehensive, and of much value at the present time when so many schemes for transmission are being considered. We regret that our space this month does not permit excerpts from these papers.

The Siemens–Halske Electric Company, at Chicago, have now completely acquired the Grant Locomotive Works, and have increased their capital to $2,000,000. The control passes to an American board with an accession of resident share-holders, among which it is said will be Charles T. Yerkes, the Philadelphia millionaire, now with his associates controlling the street railway interest at Chicago. The stock is no doubt fully represented in tangible assets, and the company aided in a technical way by the great firms in London, Berlin and St. Petersburg will hold a balance of power in that line at least. It is a saying that the Siemens-Halske Co. employs engineers instead of sale drummers, which has no doubt some color of truth. There has been a wide difference between various electric companies in this country in respect to the development of the electric arts, to some it has been a purely commercial matter and of the hour, so to speak.

The first claim of the celebrated Berliner patent on telephones, that has been first knocked down and then set up again by the courts, is one that should appall the present Commissioner of Patents. It reads thus :

"The method of producing in a circuit electrical undulations "similar in form to wave sounds, by causing the sound waves to "vary the pressure between the electrodes in constant contact, and "thereby increase and diminish the resistance of the circuit, sub-"stantially as described."

The term "method" in the first line taken with "substantially" in the last line constitutes a patent broader than the present rules of the Patent Office will permit, or should permit. There is in this claim however, a blunder of meaning, or of terms, in that "electrical undulations," the result of the method, are said to be "in the form of sound waves," and then immediately substitutes, sound waves as an element and substitute for "electrical undulations." We have before commented on this decision of the U. S. Circuit Court of Appeals, at Boston. It re-establishes the Bell Telephone monopoly, and is questionable on all grounds.

The Willans central-valve, single-acting engines made a conquest in London, and are employed for direct driving in a majority of the electric stations there. The evolution of the engine, which began about 1870 under the constant and able efforts of Mr. Willans, who was a competent steam engineer at the beginning, and an authority on the subject at the time of his death about three years ago. Now has began a struggle between the single-acting and the turbine engines made at Gateshead by Mr. Parsons, and we may also include the de Laval engine, which however does not seem to be made in England at this time. This race of motors for dynamo driving is one of much interest, and in London is no doubt typical of what is to follow elsewhere. In this country the horizontal automatic engines have held a large place for direct driving, but are slowly yielding to the vertical or inverted type.

One will think on looking over Prof. T. M. Goss' paper on "Friction Brakes," read at the Detroit meeting of the Mechanical Engineers, that there is room to devise some more simple means of measuring "torque" of shafts than is here shown; then again we must consider the skill that has been expended on this thing, and the fact that it has come through the French crucible, so to speak, and stopped where it is. We mention this because French engineers are peculiarly persistent in such things, and it is usually safe to assume that when they have taken up dynamometer apparatus and investigated it there is not a great deal left for others to work out, except construction. The flow of fluids through orifices might become a simple kind of "resistant" in such apparatus. Present brake apparatus presents a feature of crudity that may be essential, but it is hard to admit this.

MINING.

NOTES.

Luther Wagoner, the well-known civil engineer of this City, is one of a company who have purchased the old McCall Mine on the American River, in Eldorado County, and is now opening up that property, constructing new roads and preparing for hoisting and crushing by machinery. This property contains twenty-two acres of

gravel, explored to a great extent, and years of working in view. It is just below an extraordinary bend in the American River, where it is difficult to find out which side one is on. The distance from Auburn, in Placer County, is fifteen miles direct, and thirty-six miles by a possible road, and is three impassible miles from Forest Hill. Two years ago Mr. Wagoner opened the Ruby silver mines in Washington, that were ready in time to meet the depreciated price of that metal, and we trust will meet with a better future in his present venture, which has, however, included a serious fall from his horse in the mountains that came near ending a wide career in many countries and places.

The erection of smelting and refining works at Tacoma, Wash., has proved a very successful business scheme. In May last the product was 3,600 bars, valued at $76,000, and the year's run, if kept up, will come near $1,000,000 for 1895, but arrangements are being completed for a considerable extension of the plant and its output. The present working force is sixty men. The mining interest contributary to Tacoma, in a geographical sense, is great enough to occupy a very extensive works there so long as the cost of transportation remains as now, and there is the advantage of fuel cost that exists at the present time. The business is in part taken from the smelting works here, but as signs now show there will be ample business for all the refining works at present in operation on the Coast. There is also the common danger of overdoing the matter. Already there are schemes to construct smelting and refining works at several places on the upper Coast, that may spoil the business by dilution and competition.

Mr. Calvin Brown, C. E., of this City, well known to most of the prominent mining men here, has been engaged for some time past in experimenting with gold reduction processes, that are said to be very successful. We go to press this month too early to give a description of the methods, but will do so in a future issue, after visiting the plant where the process is carried on. The extraordinary diversity of methods employed and proposed for extraction, mechanical, chemical and other, must be accepted as a proof that the search is not ended. Aluminium processes prove this. There were a great number of them proposed, but now at the end of ten years we find the whole settled down to one process, that with but little variation

is generally applied. The converse of this is true in gold extraction. Every one feels there are yet discoveries to be made, and new processes are a matter of interest accordingly.

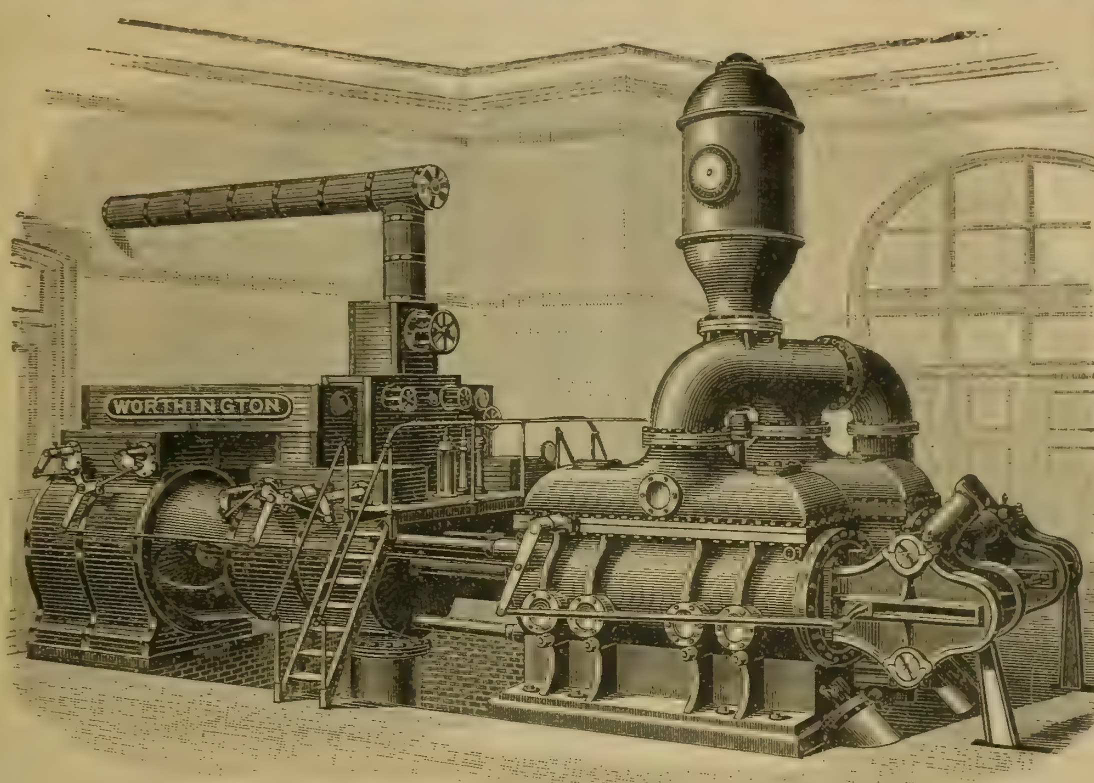
Among recent reports of gold discovery, one of especial importance is reported from Nevada County, in this State, on Cadmus Creek near Nevada City. There are said to be six ledges of the ore, and if one tenth of the estimate of its richness be true, it is a veritable "bonanza." Time will show, however, what has been unearthed in so favorable locality. When one considers the chances of outcropping ledges, and then the chances of finding them, some idea will be gained of the possibilities of mining on this Coast. The fact of mines being dotted all over the country, from Shasta to San Diego, is proof of a diffusion such as exists nowhere else in the world. Not only are gold ledges thus widely diffused, but the value of the ore, if taken on an average, is also equally diffused. There are no particular camps or districts that can boast fabulous returns, and none so poor as to be abandoned. The whole outlook over the State is promising.

The Oklahoma gold story has waned, and no doubt ended. It furnished a good deal of space for newspaper matter, and cost a good deal of money without any useful return. There was and is some gold among the sands of a stream bearing the euphonious name of "Boggy Creek," as there is in the sands of a good many other creeks, but not in quantities to justify working, and there were no indications of ledges or other origin that gave promise of better workings. It takes very little these times to set people in motion toward a prospective gold field, and as there is no possible way of arriving at facts in such cases the thing will go on no doubt. The fact is, that remoteness and inaccessibility are essential in a fake gold discovery, and the unforgotten land scramble at Oklahoma, had a good deal to do in giving spirit to the gold discovery.

Mr. T. A. Rickard, of Denver, has done the mining interest a great service during the last two years, by his investigations of stamp action and adaptation. His paper read before the American Institute of Mining Engineers, at Chicago, in 1893, on the limitations of gold stamp mills, and contributions to the *Engineering*

WORTHINGTON HIGH DUTY PUMPING ENGINES

THESE HIGH DUTY PUMPING ENGINES Have been adopted by the World's Fair Commission to supply all buildings and grounds of Columbian Exposition, Chicago 1893.



THE CONTRACT CAPACITY of **Worthington Pumping Engines** for Water Works alone to Jan. 1, 1892, **2,585,000,000** Gallons daily, which would afford a stream of water 12 hours per day, 400 feet wide, 5 feet deep, with a current 3.4 miles per hour.

Pumps for all purposes and for any pressure to 8,000 pounds per square inch. The pumps in the Mills Building, Crocker Building, Chronicle Building, Donohue Building, Union Foundry Block, First National Bank Building, Telephone Building, Lick House, Occidental Hotel, and many others in San Francisco, are Worthington.

A. L. FISH, AGENT, 59 AND 61 FIRST ST., S. F.

ALSO AGENT FOR THE

AMERICAN FIRE ENGINE Co., which includes Clapp & Jones, Silsby, Ahrens & Button Engines

BUCKEYE AUTOMATIC CUT-OFF ENGINES, of Salem, Ohio

CURTIS' STEAM AND WATER PRESSURE REGULATORS

NATIONAL WATER PURIFYING CO.'S FILTERS

Water and Gas Works' Converse Patent Lock-Joint

PIPE

Extensively used in Cities and Towns on the Pacific Coast, for Heavy Pressure, Durability, Economy.

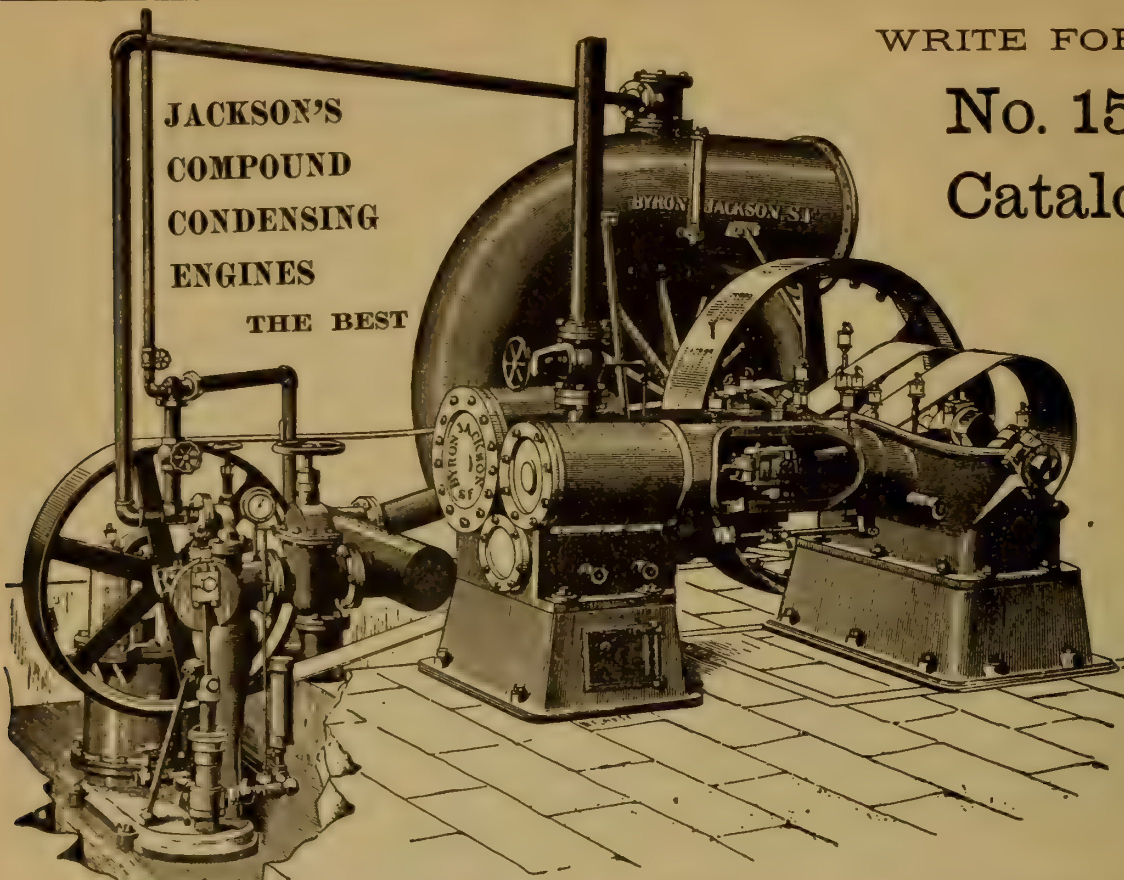
Gates, Fire Hydrants, and Full Supply Pipe Fittings and Tools

DUNHAM, CARRIGAN & HAYDEN CO.

AGENTS

17 and 19 Beale Street 18 to 24 Main Street

SAN FRANCISCO.



WRITE FOR

No. 15

Catalogue.

JACKSON PUMPING PLANT FOR IRRIGATING AND RECLAIMING LAND.

Byron Jackson Machine Works

625-631 SIXTH ST., SAN FRANCISCO, CAL.

BUILDERS OF

COMPOUND
CONDENSING ENGINES

AIR PUMPS AND JET CONDENSERS.

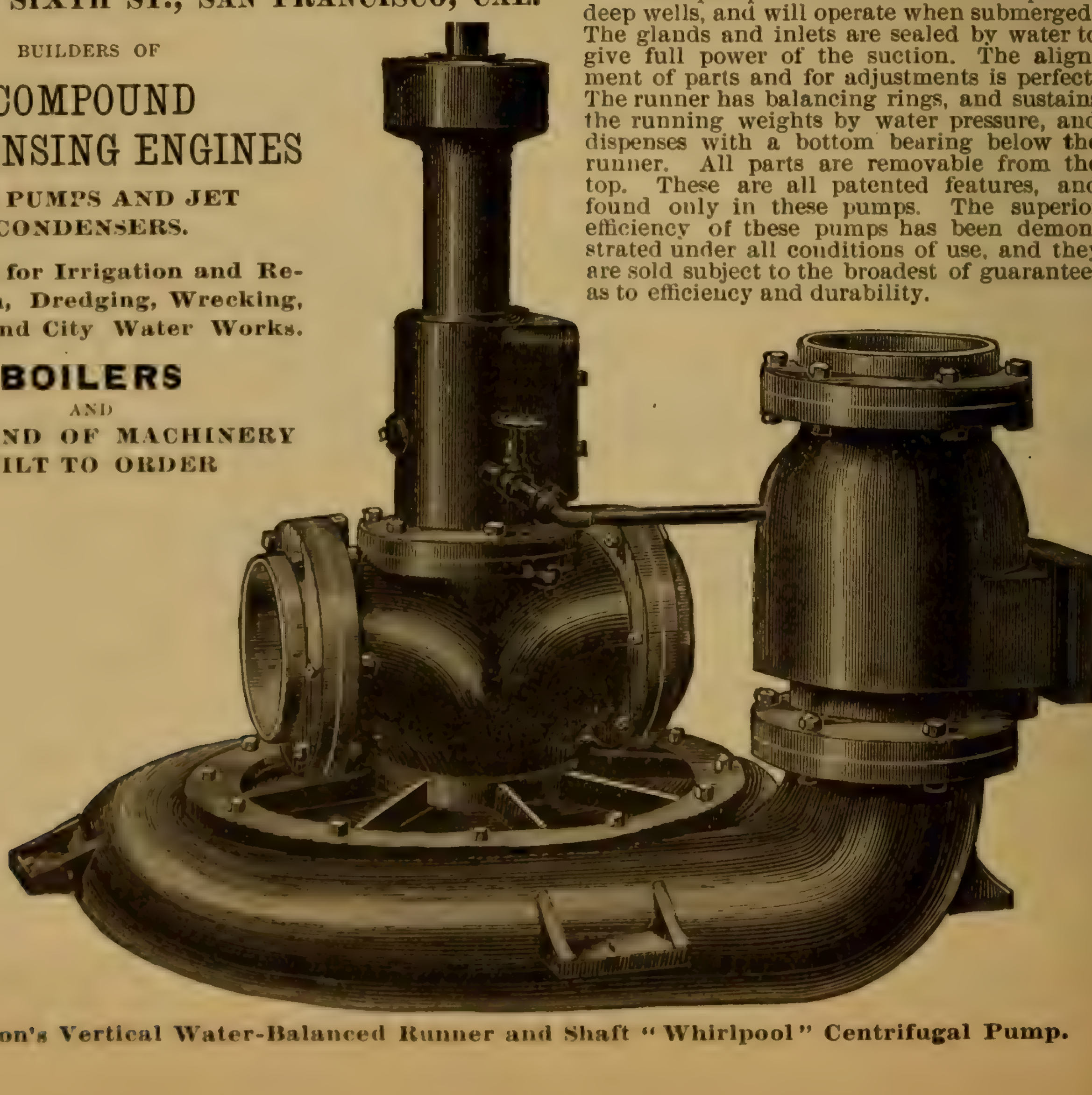
Pumps for Irrigation and Reclamation, Dredging, Wrecking, Mining, and City Water Works.

BOILERS

AND

ANY KIND OF MACHINERY BUILT TO ORDER

These pumps are intended for mine pits or deep wells, and will operate when submerged. The glands and inlets are sealed by water to give full power of the suction. The alignment of parts and for adjustments is perfect. The runner has balancing rings, and sustains the running weights by water pressure, and dispenses with a bottom bearing below the runner. All parts are removable from the top. These are all patented features, and found only in these pumps. The superior efficiency of these pumps has been demonstrated under all conditions of use, and they are sold subject to the broadest of guarantees as to efficiency and durability.



Jackson's Vertical Water-Balanced Runner and Shaft "Whirlpool" Centrifugal Pump.

and Mining Journal, in 1892-93, form a very complete essay on the subject that could with advantage be published as a treatise on stamp milling. The principle value of the work would be to makers of stamp machinery, who by custom in this country, design as well as construct stamp mills. Throughout Mr. Rickard's writings and observations, which include Australian practice, one can see that the methods are a result of "natural selection" in all old and well settled districts. The stamps vary in weight, as two to one, and in range or drop as four to one. The screens are set at heights of from 4 to 16 inches, and as it seems no constant rule is possible. The two extremes in gold stamps are the California and Colorado methods, as was noticed last month.

Just now the Brunswick Lode, a supposed bonanza lying east of the Comstock vein in Virginia, Nevada, is the principal mining topic. This lode is 7,000 feet from the Comstock, traceable for 14,000 feet on the surface, is 100 feet wide, lying at an angle of 45 degrees, and is crossed by the Sutro Tunnel. It is at present mined in several places. The lode was 113 feet thick where the Sutro Tunnel passed through it, 1,300 feet below the surface. Considering the disposition of ore in the Comstock, and the geological inferences that can be set up, it will be no surprising matter if another or several ore bodies are found to rival the original bonanza. It is a curious proposition, with a tendency to romance and speculation, but what if such a thing should occur as a new lode having the riches of the Comstock, and would it be for the better or worse except as to the owners of the mines?

There is at this time especial activity in quartz mining in British Columbia, and it is being urged with special vigor, because of its permanency compared to placer and drift mining. Over $1,000,000 worth of lead and silver from crushed ores has been sent out of the Kootenay District this year already. The mining industry in British Columbia has been of an especially spasmodic nature, beginning with the Fraser River excitement, perhaps not more so than is common in placer mining everywhere, where several millions of dollars are picked up in a short time, but lacking in every way the stability of quartz mining. We note an especial activity northward in mining machinery and appliances, which should be taken advan-

tage of here. The tendency is of course to light or prospecting machinery at first, but heavier mills will follow in due time, and connections made now may be of importance in the future. The product in gold for this year has been estimated as high as five millions, but the *Statistic News Advertiser*, of Vancouver, discredits the amount as being too great, at any rate there is an especial activity in mining matters all over the mineral districts of British Columbia.

Mr. L. Wagoner, mining engineer, of this City, gave us recently some facts respecting hoisting in a quicksilver mine in Hungary, that we think exceeds in speed any like work in this country. The weight raised is 7,000 pounds, or three and a half tons, from a deep mine, at the rate of 1,700 feet per minute, equal to 19.3 miles an hour, and about the speed of a California railway train. The winding drums are 50 feet in diameter, driven direct by two 600 horse power engines, with cranks at 90 degrees on the ends of the drum shaft. The rope is of wire, tapering from the top to provide for its own weight. There is perhaps no loss but air resistance, in moving loads at this high speed, and the gain in time is very important. We are not aware of the speed attained in the deep mines on the Comstock, or in the copper mines of Montana and Lake Superior, but imagine they are in some cases equal to the rate above given.

It would be a bold proposition to claim that the losses in silver mining will be recouped in gold mining, but that the account will in a large degree be balanced up in so far as general wealth every one must admit. Last year the production of gold in the United States was about $40,000,000, and in silver roughly $32,000,000. Taking 40 per cent. for depreciation of the latter, the accretion to gold mining will from present indications soon balance the account. This matter has of course no bearing on the money problems of our time, or directly upon the silver mining interests, but only on productive wealth. In California, from one end of the State to the other, comes accounts of new and re-habilitated mines, and much more than this is the receipt here at the mint of about $50,000 each week.

No. 86. SEPTEMBER, 1895.

Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor   Founded 1888.   W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

WASHBURN & MOEN M'F'G. CO.

WORKS:

WORCESTER, MASS. WAUKEGAN, ILL.

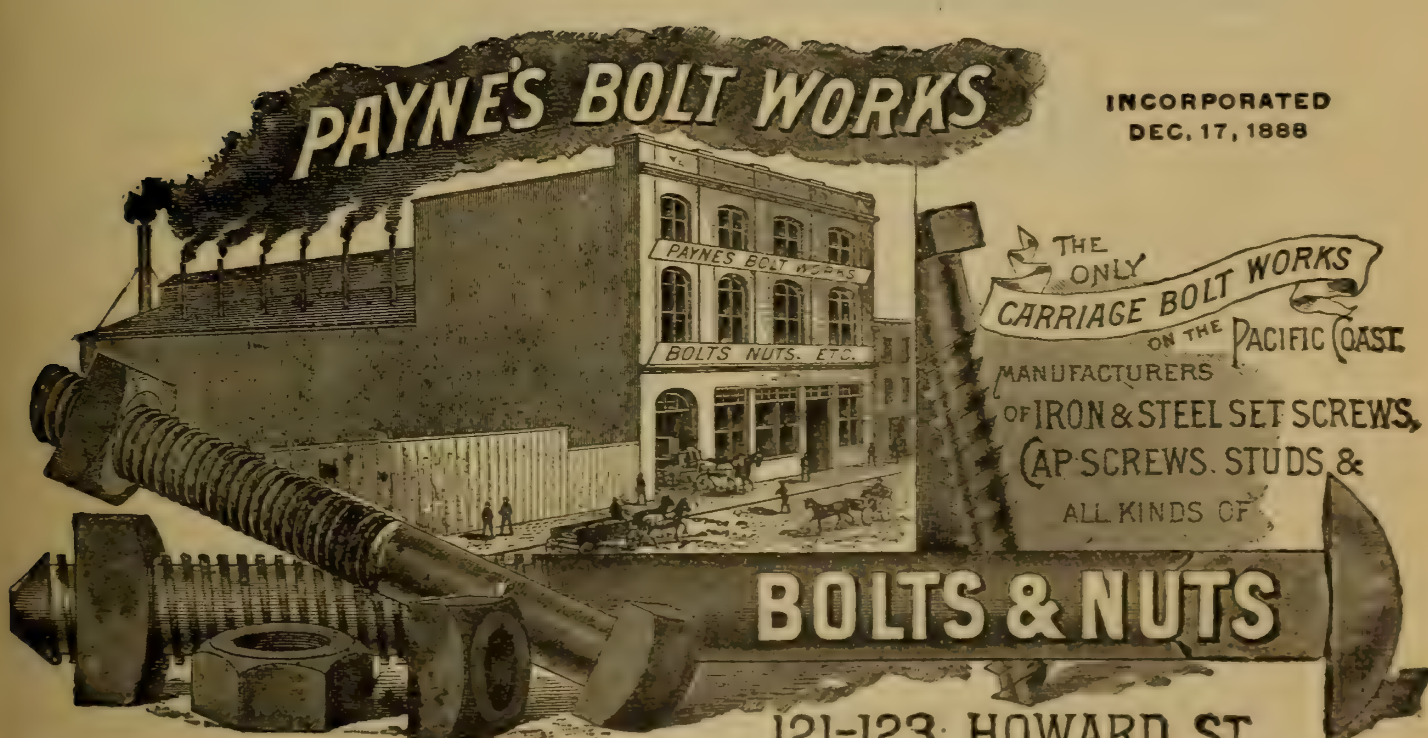
BARBED WIRE.
BALE TIES.
WIRE ROPE.

IRON AND COPPER
BARE AND INSULATED
ELECTRICAL WIRES.
WIRE SPRINGS.

SAN FRANCISCO
OFFICE AND WAREHOUSE: **8 and 10 Pine Street.**

FRANK L. BROWN, Pacific Coast Agent.

INCORPORATED
DEC. 17, 1888



Upset Bridge Rods, Truss Rods and Anchors, Turnbuckles, Head and Point Drift Bolts, Wine Cask Bolts with Brass Acorn Nuts, Cold Punched Square and Hexagon Nuts.

All Kinds of General and Special Blacksmithing

JAS. HAMILTON. WM. LEACH.

KEYSTONE BOILER WORKS

HAMILTON & LEACH, Prop's.

MARINE AND STATIONARY

BOILERS

IRON TANKS, and PLATE IRON WORK

Repair Work Promptly Attended to

OFFICE AND WORKS:

Cor. Main and Folsom Sts.

San Francisco

W. T. GARRATT & Co.

MANUFACTURERS OF

Pumping Machinery

ESTIMATES FURNISHED ON EVERY KIND OF PUMPING PROPOSITION.

Complete Line of Valves, Cocks, Pipe and Fittings Carried in Stock.

EVERYTHING FOR WATER, GAS AND STEAM.

Office, Fremont and Natoma Streets }
Works, Fifth and Brannan Streets } **SAN FRANCISCO**

ESTABLISHED 1860.

H. N. COOK BELTING CO.

Tanners and Manufacturers of

PURE OAK-TANNED

LEATHER BELTING

Patent Differentially Stretched

Cook & Houston, Patentees, 1895.

Office and Belt Factory

317-319 MISSION ST., S. F.

Eastern Agent:
L. J. SCOOFFY, 304 Broadway, N. Y.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. SEPTEMBER, 1895. No. 86

STREET-RAILWAY FARES.

Considering the fact that the street cars in this country are operated without much regard to public convenience, and that people above a certain number are compelled to stand or hang on, and there is no limit of number, one would expect that fares would be low, but this is not the case, and a recent article in the *Arena*, by Prof. Frank Parsons, should set people thinking over this matter.

A commission sent from Massachusetts found in Buda-Pesth, the capital of Hungary, the celebrated electric railway constructed by Messrs. Siemens & Halske, hauling people for a fare of 2½ cents; paying a large tax to the city, accumulating a reserve fund, and dividing earnings of eight per cent. a year.

In Berlin three fourths of the fares are 2½ cents, and the average fair on street-railway lines is 3 cents, while the operating expenses were only one half the income. The lines in Berlin are operated by horses, and had 12 per cent. less traffic than the West End lines in Boston.

In Great Britain the average fare is 3 cents. In Birmingham it is 2 cents, and in most cases the police officers see that each passenger is provided with a seat.

Cab service at Antwerp was found to be less than one fifth the rates in Boston, and commutation tickets around European cities are

less than one half what they are in this country. Professor Parsons says that in Germany the same service is secured for $4.50 that costs from $30.00 to $100.00 in American cities.

We will not quote further facts from Prof. Parsons' report, but point out that in ten years past the cost to street railway companies of conveying passengers must have been diminished one half owing to increased service, cheap iron and the various improvements introduced, but the fare remains the same.

The reasons are not far to seek. Street railways are monopolies, and almost without public regulation in this country. They drive their cars at speeds prohibited by city ordinances, haul as many as can cling to the cars, have no regulations for public convenience, not even to keep the gangways clear. In the case of electric-propelled service there is no brake power to stop the cars in such distance as will prevent accidents, and there is, as a rule, nothing paid for charters. The lines are bonded, and the money borrowed is set off as mortgaged indebtedness to avoid taxation.

Now with such methods as these what can be expected as to fares, or indeed anything else that should come within the provision of public control? "Where are we at" in these matters, and what is to be the end? Money that should be applied in reducing rates, and fulfilling the conditions imposed by charters, is expended in legal chicanery to avoid responsibility.

There is not a large American city where a careful, honest and judicious management would not permit fares to be reduced one half on all main lines. We do not care for published statistics, these are a product of "book keeping." A recent lease of the city lines in Toronto, Canada, is a better clue to the profits of the business than all the statistical tables that can be referred to.

In 1891 the city of Toronto, which is quite the same as an American city, bought the street car lines and operated them for six months, finding a profit in the transaction of $25,000 a month. The lines were then sold to a private company for reasons that are not clear, with a franchise for 30 years. This company agrees to pay to the city $800 per mile of permanent way yearly, and 8 per cent. of the gross receipts up to $1,000,000, and increase this up to 20 per cent. on all over $3,000,000, the fares to be 5 cents, or 25 tickets for $1.00. What if San Francisco had such a revenue as this from the street railways?

THE RETREAT OF THE MAYOR OF SAN FRANCISCO.

The term above is not used in a figurative sense, but literally. Mayor Sutro now and then "retreats" behind Mount St. Helena, with ramparts 4,000 feet high in front, interposed between him and the hordes that beset him, and where his army of railway builders, hotel builders, land agents, library collectors and a thousand others are cut off except by a thread of wire that reaches from tree to tree over the mountain and down into "Arcadia," where at a distance of 300 feet from his "retreat" not a break in the forest can be seen.

Even this little thread of wire can be switched off, and the world obliterated, a thing his friends constantly suggest, but he will not have it. If the ominous four bells ring (the signal is the same at Arcadia and Sutro Heights), the Mayor will cease in the midst of a dissertation on public economy in a way that startles a listener, and walk briskly to the telephone. There is no dallying there, no questions to ask. Sharp, quick and explicit the order goes out. No "ifs," "buts" or "perhaps," but that clear decisive form that has enabled one of the most wonderful men of our age to condense the work of a score of people into the life of one.

"Arcadia," 2,000 acres in area, lies directly behind the crest of Mount St. Helena, 1,700 feet above sea level, and 600 feet below the pass through which the main traffic of the great Clear Lake Basin crosses into the head of Napa Valley. It is a most remarkable place naturally, consisting of a rugged mountain side, long cañons where the sun never enters, rushing rivulets, and even large streams of cold mountain water traverse the cañons. There are glades hundreds of acres in extent, nearly level, covered with immense trees that resemble the old parks in England; in one place a spring 400 feet above the "camp" pouring out 120,000 gallons a day of water chemically pure.

The unique improvements we have called a "camp" are situated in the bottom, never visible or suspectable by any one passing 300 yards away on the stage route from Calistoga to Middletown. The Mayor has recently had a sight-way cut like a tunnel through the foliage from the fountain at his house to the highway, so that passers on the road can see at the end of the sight-way a fountain rising 40 feet in the air, also a glimpse of the principal one of a dozen unique structures that exist on his grounds.

A great volume of mountain water is brought to the place to

supply fish ponds that are disposed like terraces, one above another, each pond having a different variety of fish, all trout, but of varying colors, sizes and degrees of timidity, most of them, however, as voracious as pigs, and so tame that when the Mayor walked out on a bridge the whole surface of the water near by swarmed with the fish. Some food thrown in caused a scramble that made the water look as though a blast of powder had been discharged at the bottom.

The Mayor, discoursing on the cooling effect of the spray from the fountains, laid down some technical propositions on this subject that can well occupy some space in "INDUSTRY," his words roughly taken down were as follows:

"I discovered many years ago, twenty or more, that it was an easy matter to control both the temperature and humidity of the air in a building or room, and have been waiting ever since for some one to discover and patent the same idea. The original suggestion came from a minute leak in one of the air pipes at the Sutro Tunnel in Nevada, where a jet of mingled air and water produced such a marked effect on the air that I gave the matter some attention. A room or building supplied with air, laid on like gas or water now is, but under higher pressure, can be kept at any desired temperature, and the air at any degree of humidity, by minute jets that can be turned on at pleasure.

"I will not trouble with figuring out the expansion of the air and thermal units. The cooling action is plain enough, but the fact seems to be unknown that the air will take up and discharge as an invisible vapor, that is, not visible except near the orifice of escape, a certain quantity of water forming a delightful mixture to breathe. I will always regret that I did not inform the physicians who had such difficulty in treating President Garfield of this means of cooling the room, and sending them the required apparatus for that purpose."

Next came a dissertation on the cinnabar found in this region, now the most prolific on this continent. The Mirabel and Great Western Mines are near by Arcadia, also various others where quicksilver is produced. The Mayor's observations "beneath the surface of the earth" have been extensive, as every one knows, but the main thing in his remarks to be noted here relates to the extraction of lead from amalgam, and we again reproduce his words as nearly as they can be remembered.

"It does not seem to be known," said he, "that the lead and mercury in amalgam are liquid far below the boiling point of water.

Mercury is, as you know, liquid down to a low temperature, about 38 degrees below zero, and lead in combination is liquid, as I said, down to 180 degrees, or somewhere far below 212 degrees, and these two metals can be strained out of amalgam through a web or sack like draining water out of gravel, but I do not think it is done. On the contrary, the amalgam is treated chemically with these metals included, when at no expense at all they will run out with no other agency than their gravity. I speak from experiments made, and, as remarked, am not sure as to present processes, but strongly suspect that this mechanical straining out of lead and mercury is not commonly known or practiced."

Telephone again! Something about two millions in value of property, as a gift to the City — a college site and a library. The subject was far beyond the comprehension of a journalist. Two millions! What does it mean? As an abstract quantity it is seven figures, but in the concrete, lands, houses, books — what is it? A division of four figures might bring it down to a tangible level.

"Why," said the Mayor, "there is actually opposition to the acceptance of this! I don't understand, but it does not matter."

If a crater were to open on St. Helena, and a stream of lava start downward to Arcadia, we imagine that the mayor would calmly set to work to compute the angle and rate of advance. Those who think they can annoy him by innuendo or criticism are wasting their efforts. He seems to regard but one thing seriously, that is "obstacles," and these to be put away as a breath or to be smashed and annihilated.

Speaking of Arcadia, he said:

"The mountain forms a barrier to the fog and cold winds. It is equal to 100 miles of distance as a retarding influence to wind and fog. I want to make a great park here, or rather a neighborhood. The lands I have acquired to control them and prevent despoliation and speculation."

Beyond the Mayor's place, farther up a cañon, the existence of which is not suspected by a traveler on the road, lives Mr. H. P. Livermore, of the Folsom Water Power Company; that is, he has a summer home there, but like Mayor Sutro, has to watch his chances for a retreat. Mr. Livermore has been a quiet man, but pressing forward a great enterprise for many years, now at or near fruition.

ELECTRIC LOCOMOTIVE, B. & O. R. R. CO.—THE GENERAL ELECTRIC COMPANY.

ELECTRIC LOCOMOTIVE, BALTIMORE AND OHIO R. R. CO.

CONSTRUCTED BY THE GENERAL ELECTRIC CO.

The installation of an electric service across the City of Baltimore for the Baltimore and Ohio lines marks a considerable advance in electrical engineering practice. The whole equipment is massive, and has been prepared with the care necessary in providing an independent link in a service between the commercial and political metropolis of the country, and where there is a service as fast, and as well organized, as on any line of the kind in the world.

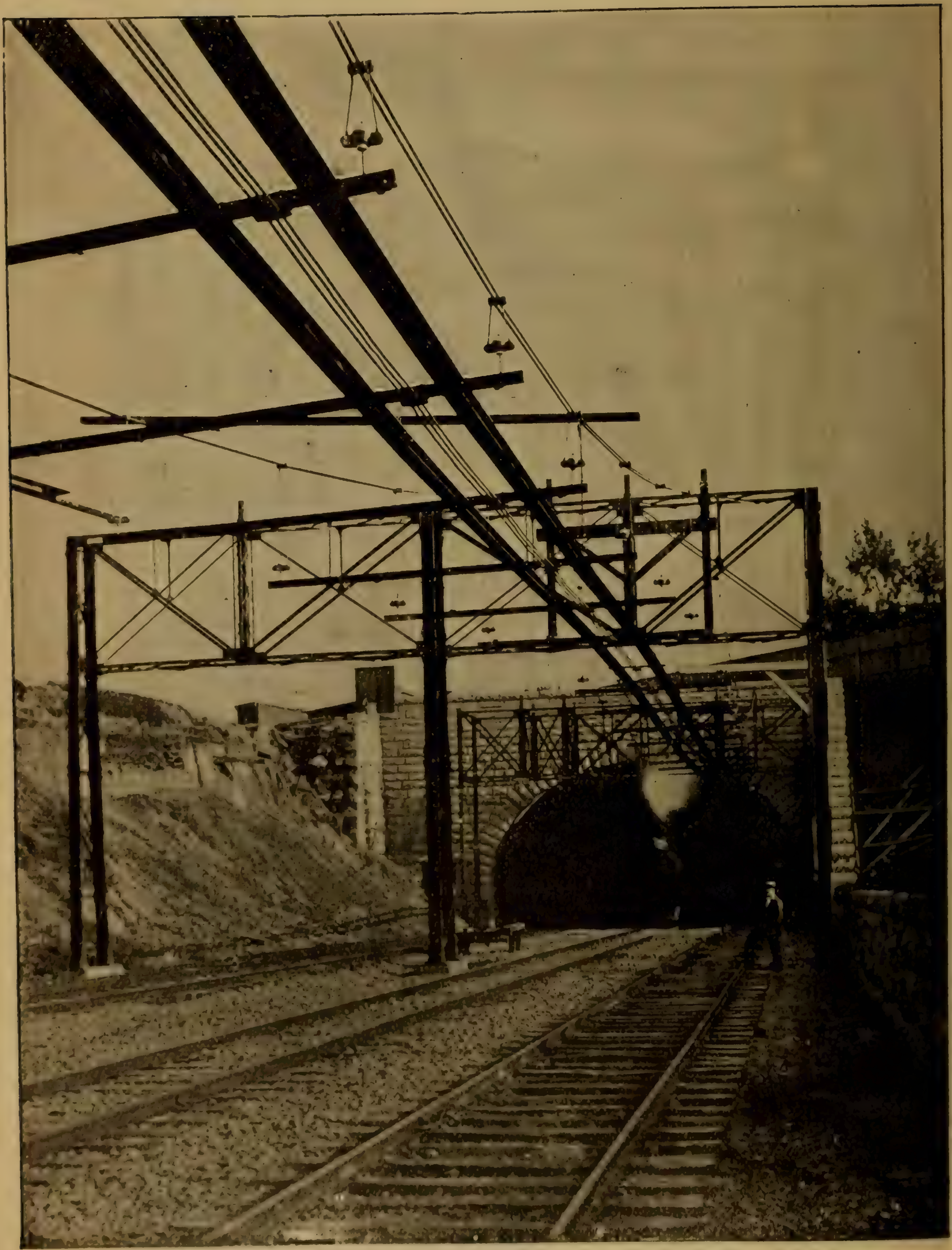
Those who have traveled between New York or Philadelphia and Washington will remember that down to a dozen years ago the trains were hauled by horses from and to Camden Station across the City of Baltimore, the Washington and Western Station being on the northern side, and also will remember how later on the trains were ferried across an arm of the Potapsco Bay, both methods causing delay.

Most people will remember also how the Pennsylvania Company by various kinds of strategic procedure "tunnelled" through various law writs and injunctions, and at the same time beneath the northern side of Baltimore, thus securing a continuous line from New York and Philadelphia to Washington and the West.

These two great lines, the Pennsylvania and Baltimore and Ohio, have for twenty-five years carried on a war of rivalry, contending for the eastern and western traffic. First one and then the other line would by some bold stroke astonish the people, who were all the time gainers in this battle.

The Baltimore and Ohio Company were compelled, we may say, to cross Baltimore without the delay consequent on breaking their trains, and have like the Pennsylvania Company, cut and tunnelled a distance of seven miles under the center of the city. The main section of the tunnel is 27 feet wide, 22 feet high and 7,339 feet long, made at a cost of $1,650,000.

It is for service in this tunnel and belt line that the electrical equipment is provided, the object being to avoid the smoke and gases of combustion from steam locomotives, which it was thought could not be driven out of the tunnel, and would be obnoxious to passengers. One of the electrical locomotives is shown on the opposite page. It weighs about 100 tons, and is of 1,140 horse power, provided with four motors. Some of the particulars furnished by



Entrance to Tunnel, B. & O. R. R. Co.

the General Electric Company are as follows: Number of trucks, 2; number of motors, 4, two to each truck; weight on driving wheels, 192,000 pounds (96 tons); number of driving wheels, 8; drawbar pull, 42,000 pounds; starting drawbar pull, 60,000 pounds; length over all, 35 feet; extreme width, 9 feet 6¼ inches; diameter of sleeve bearings, 13 inches.

The company have courteously sent plates to illustrate the generating, transmitting and controlling elements of this great plant, but our space does not permit the use of more than are given; one of a locomotive, and a wonderfully successful photoplate of the tunnel entrance, shown on the opposite page. The equipment includes the generating machinery for power, and also for lighting the tunnel and power stations, all of which seems to have been carried out in a manner highly creditable to the General Electric Company and to American engineering practice.

We neglected to explain that in order to avoid delay these electric locomotives will not be substituted for the steam ones, but will come behind the trains and push the whole, including the engines, through the tunnel, so there will only be a few minutes delay, indeed none at all if it were not to accommodate the Baltimore traffic in the stations at each end of the electric run.

OWENS RIVER VALLEY.

Dr. Thomas M. Chatard last year in a lecture on the "Natural Soda Deposits" in this country, gave a description of the Owens Valley and Lake in Mono County, this State, that has a good deal of interest, being derived from personal observation on the ground. The following is an extract:

"Proceeding southward from Mono Lake we pass over a highly volcanic country and reach Long Valley, in which the Owens River originates. This valley is full of alkali flats, morasses and pools, the alkali being, as before, derived from the decomposition of the volcanic rocks, a process which is now going on and can everywhere be observed. The drainage of the valley is by the Owens River, a stream which carries a considerable amount of alkali, all of which finally reaches Owens Lake, Inyo County, Cal.

This lake is the most important occurrence of natural soda in the world. Its area is even greater than Mono Lake, being over 100 square miles, with an average depth of not less than 17 feet. It is readily accessible, as the Carson and Colorado Railroad runs along

the eastern shore, and can be easily reached by all of the great continental lines.

The lake lies between the Sierra Nevada on the west, and the Inyo Range on the east, and has no outlet, the lowest point of the rim of the valley being, as I am informed, about fifty feet higher than the present level of the lake. On the western side several small brooks from the Sierra make their way into the lake, but the larger portion of the water supply comes from the Owens River, which empties into the lake at its northern end. This stream was, in February, 1892, about 59 feet wide, 5½ feet deep, and had a flow of about 3 miles an hour. These measurements represent a considerable amount of water, but represent probably not more than two thirds of the daily supply, and one gets some idea of the aridity of the climate, and of the rapidity of evaporation, when one remembers that although the lake is naturally somewhat higher in the spring than in the autumn, the average depth suffers but little change; hence at present the evaporation from its surface seems to be about equal to the amount of water received from all sources. As the valley lies between two high ranges of mountains, and is open to the north and south, there is usually a good breeze through the greater part of the twenty-four hours, thus much increasing the evaporation, which may be safely taken as over five feet per annum.

* * * * * * * * * * *

The scenery of this valley is very attractive, and the soil where-ever irrigated has proved itself to be very fertile. Very little snow falls in winter, and work can be done throughout the year. Even in summer although the thermometer shows a high degree of heat this is not oppressive, because of the dryness of the air, and sunstroke is, I believe, unknown. The highest temperature I have ever noted, the thermometer being in an exceptionally well-shaded place, was 109° Fahrenheit. Hot as this may seem I spent the entire day at work in the sun, with no protection and inconvenience, nor did any of the men working around me make any complaint. Indeed, a wilted collar is an impossibility in such a climate, as perspiration evaporates as fast as formed, and it is only necessary to drink a reasonable amount of water, and that not too cold, to have a far more comfortable time than is given to us by our Eastern summers. What is said of Owens Valley is true of the entire western side of the Great Basin, and whatever you may hear of the hardships that travellers may undergo rest assured that those who are acquainted with the region find our Eastern climate much inferior."

Dr. Chatard says that at Owens Lake alone there are facilities of space and otherwise to permit the production of 250,000 tons of soda ash each year, or as much as is consumed in the United States.

STATE TAXES ON SHIPPING.

The Hon. Eugene T. Chamberlain, United States Commissioner of Navigation, some time since submitted to Solicitor F. A. Reese, of the United States Treasury, an inquiry respecting the powers o Congress under our present Constitution and laws for regulating the taxation of vessels engaged in foreign commerce.

Commissioner Chamberlain, who has from the beginning of his administration had in view some means of relieving American shipping from oppressive local taxation, has called more attention to the subject than it ever before received, and his labors will no doubt bear fruit in the end.

The local taxation of foreign-going ships, if we except the vagaries of assessment, is a bad feature of the laws of this State that has much discouraged commerce, and is besides unjust, but according to the Solicitor of the Treasury there is no power in Congress to prevent the imposition of these taxes. The Solicitor points out that Section X of Article I of the Constitution says: "No State shall without the consent of Congress lay any duty on tonnage," but there is no express prohibition as to any other tax on vessels engaged in commerce. In various court decisions, many of which are cited, the fact is set forth that ships can be taxed as private property in the various States of the Union. This settles the point in so far as can be seen.

It will be useless to repeat here the arguments and facts presented by Commissioner Chamberlain and hundreds of other people since he has raised the issue, to show that ships are not like other private property, because not enjoying or using the benefits for which taxes are assessed, and have to purchase the privilege of landing at ports which they are taxed to maintain.

Mr. Dickie, of the Union Iron Works, has on several occasions in a public way shown the unfair and illogical character of such taxation in respect to this port, where a ship must pay for street maintenance, lights, police service, etc., which the ship does not use, and even then must pay for the privilege of coming to a dock to unload.

Ships are an ancient kind of property, and this very problem must go back to the Phœnicians. It is a disgrace to our age, and as illogical as anything can be, unjust too, but worthy of an average Congressman or a Senator with railway interests.

FIG. 2.

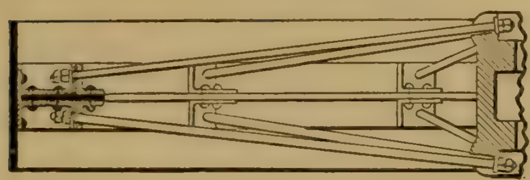


FIG. 3.

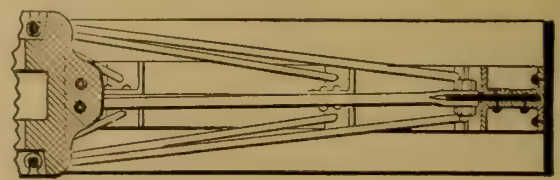


FIG. 4.

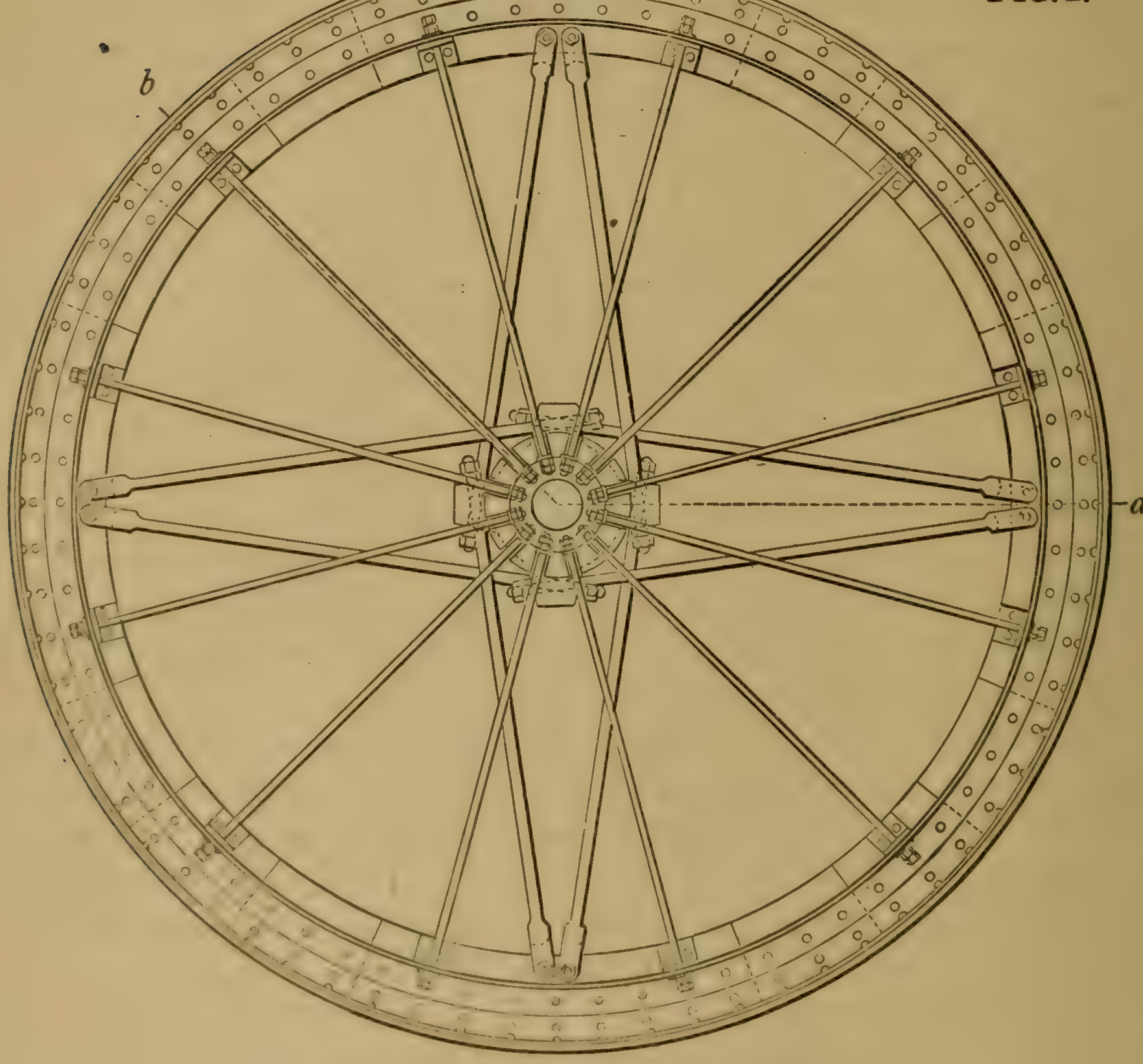


FIG. 1.

AN EXAMPLE OF WHEEL CONSTRUCTION.

DESIGNED BY E. S. COBB, M. E., SAN FRANCISCO.

One would suppose from the universal use of wheels of all kinds, and the careful attention that has been given to the properties and disposition of materials in their construction, that the art had

reached the ultimate, but some study of the example here given, if we mistake not, will disclose new features of interest.

The failure of large wheels during five years past forms a long list of serious casualties, showing that the increased rate of rotation demanded in modern practice has not been met by the conditions of construction. At the same time every one knows that the physical properties of common material provides strength far in excess of any demands that working conditions should impose.

Mr. E. S. Cobb, of this City, was called upon some time ago to design a large tangential water wheel, 17 feet 4 inches in diameter, with a limit of weight and cost, and a guarantee of strength and stability. This led him to consider carefully the various methods of constructing large wheels, with the result that he has produced a structure for which the following claims can be made.

All the strains are tensile, and all simple in respect to each member. The whole value of the material is utilized in resistance to centrifugal and driving forces, and bending strains are eliminated. At the same time the sections throughout correspond to those in common use, rolled from fibrous iron or steel.

The rim sections, seen in Figures 2 and 3, are composed of four angle-iron bars, a radial center plate and a covering band, but these can be modified in various ways to receive toothed segments, rope grooves, or a fly-wheel rim. The present design, for which dimensions are given further on, is for a driving band wheel.

By examining the disposition of the various members it will be seen that when the wheel is in motion, all of its members are in tension, except one chord of the driving trusses, of which there are two.

The radial rim-supporting spokes have no function except to sustain the rim and resist centrifugal strain. These spokes are set oblique to give lateral support, and are adjustable, so as to set the rim true and concentric, also are removable separately without disturbing other members.

The turning strain on the driving truss rods will be understood by the diagram Fig. 4, showing the lines of force, the disposition of the parts constituting a symmetrical beam to resist or impart strain about its axis, or to the shaft on which the wheel is mounted. The provision for lateral stability is ample, as will be seen in the sections. Fig. 2 is taken on the line *b*, and Fig. 3, on the line *a* of Fig. 1.

It will also be seen that this construction affords convenient means of adjusting the rim laterally, also for rotundity, and setting it concentric with the axis or shaft.

Mr. Cobb sends the following particulars of the wheel shown in the drawings:

FLY WHEEL FOR AN ENGINE, 400 TO 500 HORSE POWER.

Diameter over all	18 ft. 2½ in.
Width of face	30 "
Diameter of Shaft	10 "
Length of hub, bore	22 "
Length of hub over all	32 "
Center to center of spokes laterally at the hub	26 "
Center to center of truss rods at the hub	32 "
Diameter of radial spokes	1½ "
Diameter of truss rods	2 "

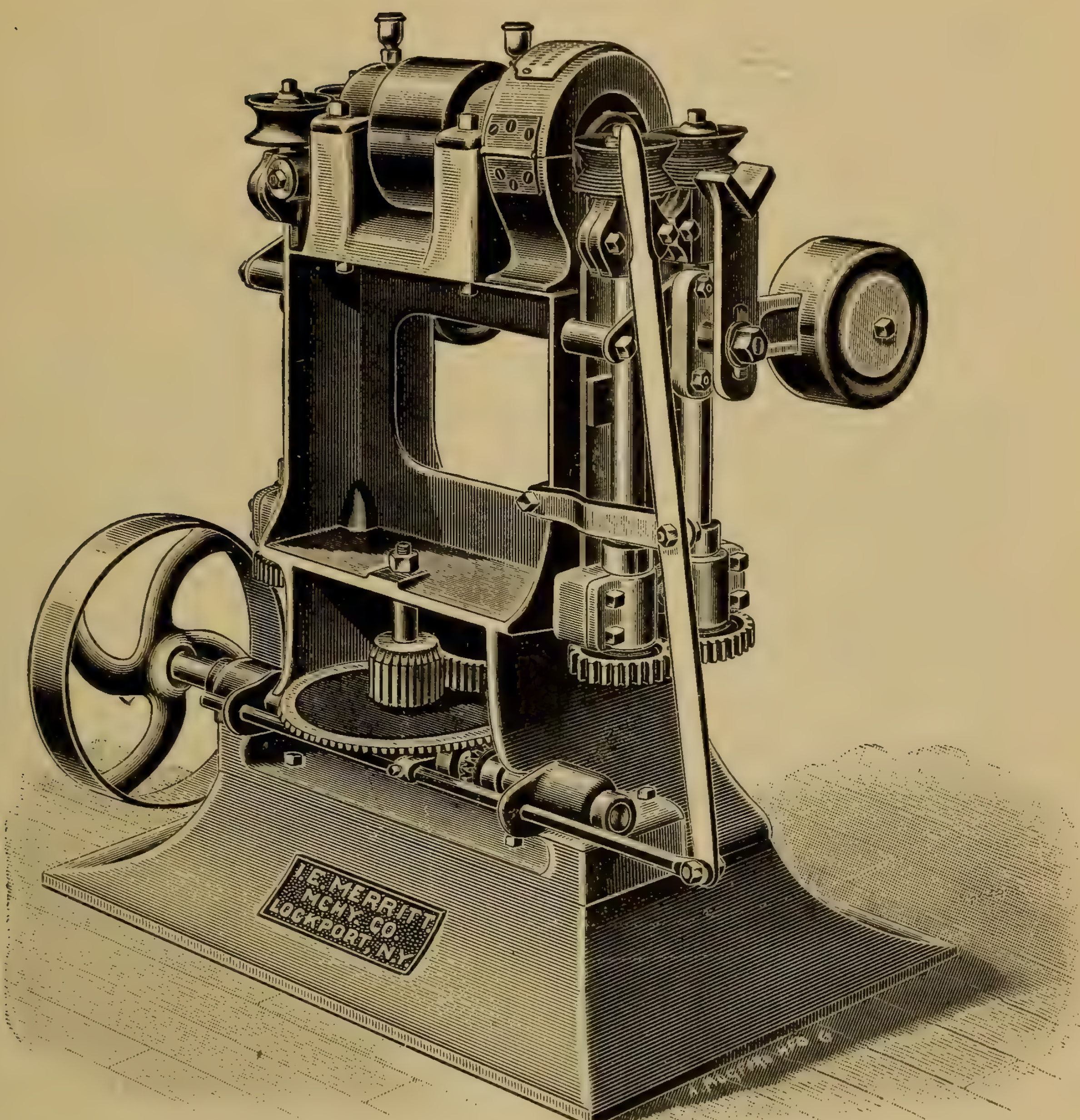
Weight of rim	11,500 lbs.
Weight of spokes	2,000 "
Weight of hub	3,300 "
Total weight of wheel	16,800 lbs.

Weight of rim per foot	210 lbs.
Gravity radius of rim	8.58 ft.

At 120 revolutions per minute the whole of the centrifugal force could be sustained by the radial spokes, twenty-four in number, with a tensile stress of 11,130 pounds per inch of section. The rim taken at seventy-five per cent. of its actual section, when sustaining the whole centrifugal strain at the same speed would only be subjected to 1,244 pounds per inch of section, and these two members combined, made of merchantable steel, will show a resisting value up to a rim velocity so great as to be far beyond any possible condition of use, or even of accident.

There is also furnished some computed data respecting cast-iron wheels, for comparison. This we omit, believing there is no *known* value for cast material in wheels. We have only what is derived from observed results, and calculated values are of little use.

Mr. Cobb is arranging tables of reference for the various components in wheels of this kind, and is prepared to furnish designs, weights and estimates for wheels of all sizes and strength based upon the methods of construction that have been described, and in accordance with various features now the subject of patent applications in this country.



ROD TURNING MACHINE.

THE I. E. MERRITT CO., LOCKPORT, NEW YORK.

Among a number of designs for machines of this kind that have recently appeared, the one above has advantages of arrangement and convenience, that will be obvious. The cutter heads are enclosed, and if this is practical without clogging with shavings, it is a very desirable feature. The weight, price and room occupied, is such as to leave no reason for the custom of preparing round rods on moulding machines. Such work is never perfect as to shape, or so smooth as is produced on machines like the one above shown.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO."

No. XXXIII.

BRAHMANISM.—A HIGH COUNTRY.—SOMETHING ABOUT MIRACLES. HYPNOTISM.—A NOVEL TYPE OF STEAMBOATS. IMPROVING A RIVER.

———At the hotel in Tacoma we found a number of foreigners, mostly Englishmen, travelers "taking in" and doing the country, as one of them said, and among others a sedate-looking man that his companions called "Brahma," a name bestowed as we learned because of his belief in the faith of that name. To myself, no doubt to most other people, this seemed a most miraculous and heathenish idea, and I mentioned as much to my Uncle. It was the greatest mistake I ever made. My Uncle I knew had lived in India, and had noted among other things the faith of the people there, at least he notes everything, and as religion is the most prominent feature of social life in India I might have been more cautious, and first learned his views of the Brahma matter.

"A Brahman!" said he, "what of that? What do you and the rest who are quizzing this man know of Brahmanism? When Egypt was young, a thousand years before Greece and Rome, these people had progressed farther in the study of the human mind and being than any other people have to this day. The center of Brahman faith is in Thibet, where no one goes, and no one can go, to stay at least. It lies 14,000 feet above the sea, and demands physical and anatomical conditions that came of evolution, lungs to hold twice as much air for one thing. A few people, perhaps not a dozen in all, of our race have penetrated this country, and not one in a million of them knows what Brahmanism means.

"As I said, five thousand years ago Hindoo philosophers had progressed farther in fundamental knowledge than we have today. Their country was covered with fine cities, canals, reservoirs, terraced gardens, temples and palaces, so graceful and beautiful that the best we can do now is to make imitations of them. They had little scientific knowledge, and so much greater becomes their achievements, especially as all these things were done without lying, cheating, murder and other concomitants of our modern civilization, at least there is no record or tradition of such vices.

"I have seen the mango seed planted in India, and in thirty minutes grow to a tree before our eyes. Legerdemain you call it, first, however, disputing the fact. I have seen it, or thought I saw it. What does it mean? A power over the human mind of which we have no knowledge except a mere fringe we call hypnotism, and that a mystery. The miracle was not performed for money, but for the same reasons that Christ performed his miracles, and was followed by a sermon that lifted the human mind far above the plane fixed by our Western sciences.

"I am not of a credulous nature, and believe in the immutability of physical laws, as any one dealing with modern science and mechanics must do, otherwise be considered a fool, but when it comes to the laws that govern the human mind, and the relations that life bears to matter, we must go to the Brahman to learn.

"The man who planted the mango tree had been doing that very same thing his whole life, so had his father and his grandfather before him, so had his projenitors for thousands of years before. The mango tree is an inconsequential matter, but the power that made it grow, blossom, bear fruit, wither and disappear in sixty minutes, that is the point. This man had no clothing to exceed a dime in value; his food, a cup of rice, was not worth two cents, and these things were given to him. His business was to study the human mind, and this he had done to some purpose.

"Another man would cast a coil of rope upward in the air, where it would remain rigid; then he would climb up the rope. Don't laugh at this. Thousands of people have seen the same thing, or thought they did. There was no stage, or stage apparatus, no gas light, or anything to promote deception. All was done in the open air, not for pay, as I before said, but as an experiment on the human preceptions, and now I come to the point. A people who have thus studied the human mind and soul of man are very apt to attain to a high religion and system of morals.

"No one of you who are laughing at our friend knows what the term Brahma means. Neither do I. I am not advanced enough in knowledge and the powers of preception to understand it, but one thing I can explain, it does not mean a "thing," a creed or even a condition, that can be expressed in terms of our language and modes of thought.

"Our friend is not a Brahman, he cannot be. He has only attained a decent respect for a wisdom of which he is conscious. He has no doubt seen the mango tree grow in the streets of Benares.

He may have been on the plains of Thibet, or even at Thibet, but let this be as it may I am sure that his reverence for Hindoo wisdom is based on some reason that does honor to his judgment and the better feelings of his nature."

——————This extraordinary sermon, here noted down imperfectly, was a revelation to me, and I lost no time in some further inquiry and reading on the subject of Hindoo faith, and conclude that if instead of technology and mechanics I had devoted as many years to mental philosophy I might be in a position to understand something of human desires, passions, senses and spiritual life as taught in Eastern philosophy, as it is I give it up.

As to Hindoo magic, as we term it, every one has read of that, and as a reality have scoffed at it, properly so, because it will not square with the laws of gravity, and other fixed principles that no one can doubt, but we never think of the minds and imagination of those who are looking on.

A German traveler, Dr. Hensoldt, has recently made his way into Thibet and written of esoteric science there in a way to disturb one's mind, but this digression, covering many pages in these notes, has gone far enough, and is excusable only on the grounds that many scientific men of our day have taken up this subject of occult science in the East, and we may soon look for some rational, or at least possible, explanation of the mango trees and rigid ropes.

——————At Portland, Oregon, on the Willamette River, near its mouth, and nine miles below where this river tumbles over a cliff, we found a good many interesting things, a strange mixture of the head and tail, so to speak, of industrial art. Among the head things were stern-wheel steamboats, that had some approximation to the lines and make-up of theoretical marine craft, especially below water-line, and the fact caused both myself and my Uncle a good deal of concern. In the first place the wheels were much smaller in diameter than on our Western rivers in the Mississippi Valley, not more than two thirds as large, a fact that no one seemed to be aware of, and which is yet unexplained.

Going on board of one of these steamers we found geared to one of these small wheels a pair of engines that by inference should have spun it around regardless of the water at a rate equal to a wind-wheel in a gale, but nothing of the kind took place. We made a short journey in that same boat, up to the Cascades, about six hours' run, and the little wheel hung to the water like the rack pinion under a mountain locomotive, and there was no slip.

The engineer said it was the form of the hull that had a clean "run" and left solid water at the stern for the wheel to work in, which seemed a contradiction, because a bluff flat-bottomed barge, like on the Mississippi hulls, leaves a following wake, dragged against the wheel, so it seems at least, but this will not do, because here is ocular proof of the contrary, and the undisturbed water theory must stand for the present.

The engines were the best I had ever seen on a "wheel barrow" steamer, were well managed and pushing along a boat to carry 800 tons of freight eighteen miles an hour, with a cord of wood for fuel in that distance. One boiler, a huge firebox one, set amidships. The whole thing was a revelation in stern-wheel boats, and deserves a dozen pages here if I knew how to write them.

The Cascades are well named, and make a complete bar to navigation. The Government in a kind of desultory way is making sluices at the head of the rapids, and will be for many years to come, but how a boat is to get to these sluices or locks up over half a mile of rapids, or go down over them, is a problem in "occult science." There will be a canal, no doubt, but there will be time enough to think of this in the remote future.

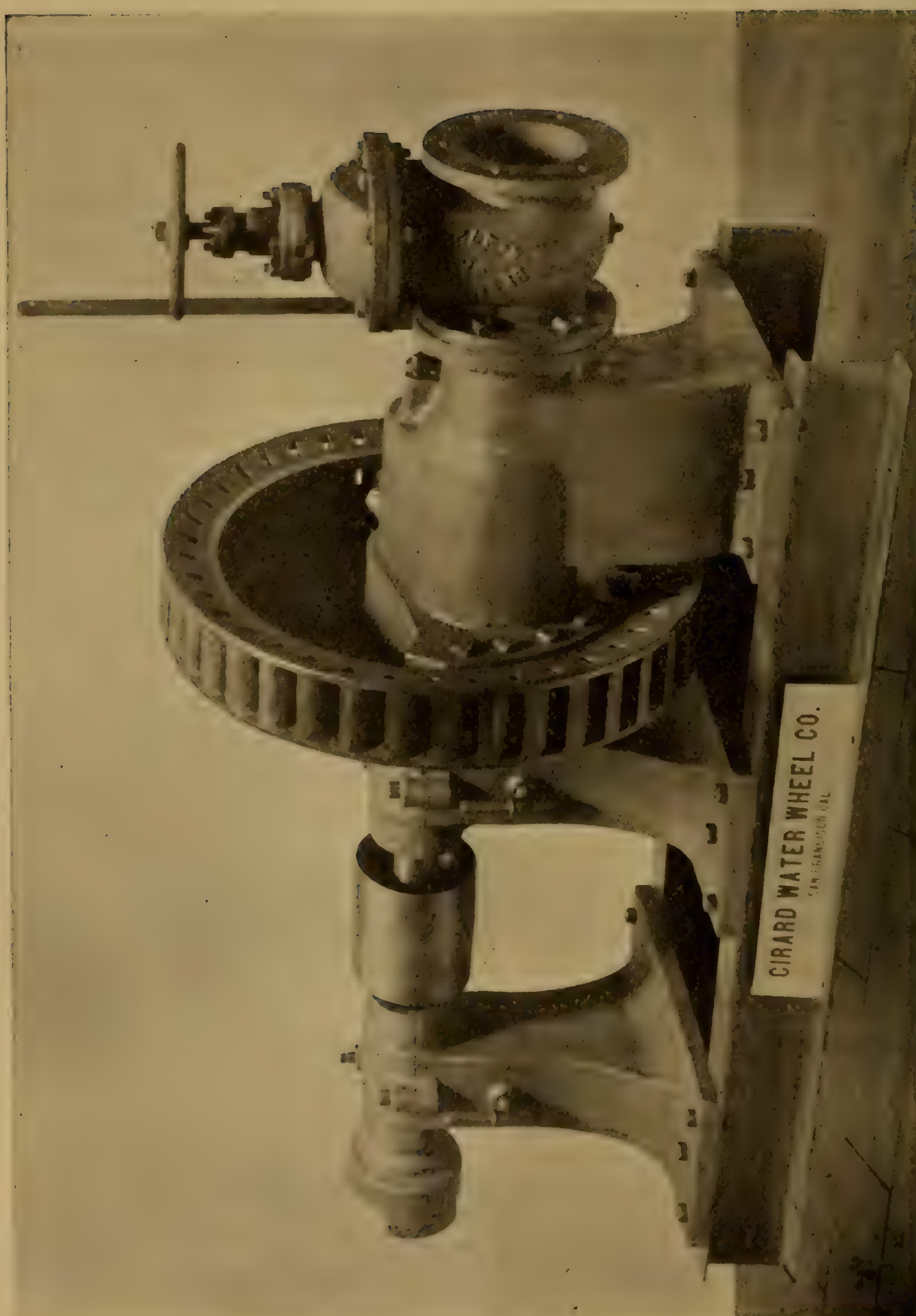
In a Government of and for railways, the improvement of waterways is a kind of sham set up to catch opinions and votes. It is like dredging out the channel to Galveston harbor, and letting out there the products of the Southwest that are now carried by railways to Eastern ports. It is not likely that any one now living will see a channel to admit ocean steamers to Galveston, and are as little likely to see steamboats going up over the Cascades and Dalles, other rapids farther up. This would be direct interference with railway interests, and not to be tolerated. This idea is my own, the evidence is open to every one, except as to facts of the future.

(To be Continued.)

RAINFALL AT SAN FRANCISCO.

Mr. W. H. Hammon, officer in charge of the U. S. Weather Bureau here, has issued a very useful and interesting bulletin, from which we reprint the following excerpt:

"Considering the record of the past 25 years, made in this City by the United States Weather Observer, it is found that the average date of the first 0.05 of an inch of rainfall occurs by September 17th. Considering June 30th as the official end of one season, and July 1st



40 H. P. Girard Water Wheel.—Girard Water Wheel Co., San Francisco.

the commencement of the next season, we find that the earliest date of 0.05 of an inch of rain is July 8th, 1885, and the latest October 27th, 1875, that is from July 1st to October 27th, 1875, only 0.05 of an inch of rain fell. As 0.05 of an inch of rain is such a small amount, it has been deemed best to consider that when one quarter (0.25) of an inch of rain has fallen, that that date be considered the commencement of the rainy season. Using this then as the basis we find that the rainy season begins on October 8th.

The earliest date of a quarter of an inch is September 8th, 1884, and the latest not until November 23rd, 1880. As one quarter of an inch of rainfall at San Francisco is hardly sufficient to allow of rainfall over the southern portion of the State, a basis of one inch at San Francisco was considered for the southern portion as the commencement of the rains there, and this is found to be November 1st.

The earliest date of one inch of rain is September 15th, 1888, and the latest December 3rd, 1890. One inch of rainfall at San Francisco is not sufficient for the interior of the State to allow of good plowing and seeding, hence a total of 2.00 inches at San Francisco was considered and it is found that 2.00 of rainfall at San Francisco up to November 13th, hence that date can be said to be the date of commencement of good plowing. 5.00 inches is considered as the rainy season, being here in full effect, and it is found that 5.00 inches does not fall before December 15th, and that the earliest date that 5 inches have fallen is October 21st, 1889, and the latest February 5th, 1891. In this latter season February was very wet, and the total for the season was 17.58 inches.

To summarize we have first rains September 17th; rainy season begins October 8th, and in southern portion of the State November 1st; ground moistened for plowing November 13th, and rainy season in full effect December 15th."

40 HORSE POWER GIRARD WATER WHEEL.

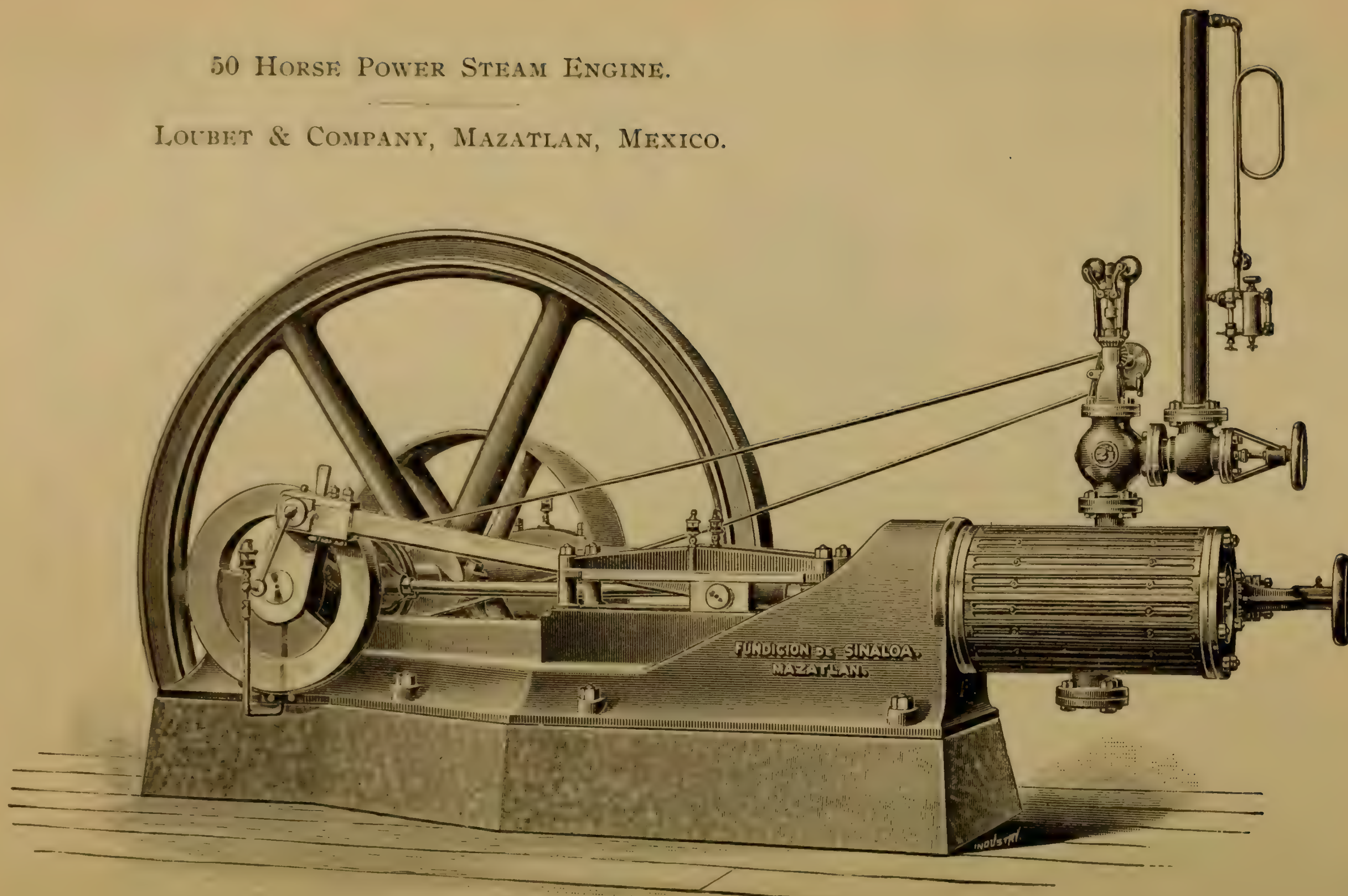
THE GIRARD WATER WHEEL CO., SAN FRANCISCO.

The plate opposite represents a special water wheel, 26 inches in diameter, made for a mine in Placer County, to perform an irregular duty under a head of 350 feet. There are a number of independent issues covered by an oscillating valve or gate that opens and closes the issues one at a time as the power required may demand, so there is no waste of water because of the varying load.

The wheel is for driving a saw mill, and is controlled in the usual manner by hand gear, the power and amount of water being varied with each cut and with the depth of the timber being sawed. This constitutes a severe duty, to which the Girard type of water wheels is well adapted, being capable of receiving a large volume of water on a small wheel.

50 HORSE POWER STEAM ENGINE.

LOUBET & COMPANY, MAZATLAN, MEXICO.



EXAMPLES OF MEXICAN ENGINEERING WORK.

LOUBET & CO., MAZATLAN.

On the opposite and next page are illustrated a horizontal slide valve engine, and centrifugal pump, by Messrs. Loubet & Co., of Mazatlan, that show good practice, and from recent advices we are informed that a great advance is being made in various kinds of mechanical work all over the Republic.

This fact argues well for all concerned, and especially for firms here who send machinery to Mexico, because competition in good work promotes trade and need not be feared. It increases prices and confidence, also shows an advancing market.

Neither of the machines shown require description; the drawings render this unnecessary. The engravings were made by A. H. Markley, who executes most of the engravings for "INDUSTRY." These are faithful to the original designs in all respects.

PAST AND PRESENT WAGES.

Once a week, or oftener, one comes across comment on the increased rate of wages of workmen during half a century past, and now Mr. Chauncy Depew has descended from his sphere, to note the fact that workmen now receive 25 to 50 per cent. more than they did thirty years ago.

No one disputes this, but the question is, do workmen receive an increase relatively more for services than other people? On any other grounds the matter is mere sophistry or worse. Mr. Depew we believe, receives $25,000 a year for his services, will he claim that he could have procured thirty years ago a salary equal to that of the President of the United States, for acting as chairman of a railway board?

The chances are that his pay, and that of others in like positions, has advanced one or two hundred per cent., while workmen's wages have increased only 25 to 50 per cent.

Every one and in all pursuits receive increased incomes, consume more and live better. Is it then to be argued that workmen alone are to remain at their old rate of wages? We have heard enough of this specious argument, unworthy a place in the mind of any one capable of logical reasoning or even a simple observance of facts.

12-INCH CENTRIFUGAL PUMP.

LOUBET & CO., MAZATLAN, MEXICO.

TUBULOUS MARINE BOILERS.

Assistant Engineer J. K. Robinson, of the U. S. Navy, has not been converted to a belief in Bellville boilers for marine purposes, and writes of the matter in the *Journal of the American Society of Naval Engineers*, in respect to the French boilers. The following is an extract:

* * * "The extremely small quantity of water in the boiler has made the use of an automatic feed regulator necessary. This regulator works well when it does work, but fails to work at all often enough to destroy all confidence in it. Besides when the regulator fails to work, serious accidents often result. The amount of feed water is so small, that any failure of the regulator to act is liable to cause the water to disappear entirely from the boiler. The small quantity of water in the boiler likewise causes large variations in the steam pressure and necessitates a larger pressure in the boiler than at the engines; that is to say, there is a reducing valve between the boilers and the engines. The circulation of the water causes the tubes to deteriorate very rapidly if the water is not pure. The tubes of the lowest row are made very thick, but they wear out very rapidly nevertheless, being bent after the fires are lighted under the boilers two or three times. The system of circulation of the water causes a great deal of 'priming,' and this can not be cured, even with the use of a complicated set of baffle plates in the steam drum of the boiler, and with the addition of a separator between the boilers and the reducing valve. The reducing valve must also reduce the amount of water in the steam, though, as has been seen, this is not the prime object of its use. It has been estimated by engineers that have worked these boilers for several years that the amount of water in the steam at the cylinders is never less than 10 per cent.

The use of the Bellville boilers, was said at the outset to be sure to give a great gain in economy of fuel. In fact, many engineers still seem to think that they are not greatly inferior to the Scotch boilers in this respect. The fact is, however, that the arrangement for the combustion of the coal to take place entirely in one place has made the mixing of the gases of combustion very poor. To ensure their proper mixing all the gas from the grate should be brought together at some point before the combustion is supposed to be completed. This would correct the inequalities in the thickness of the fires in different parts of the grate. So very poor is the mixing of the gases in the Bellville boilers, that it has been found necessary to have a pump for forcing jets of compressed air in the top of the furnace, forcing the gases of combustion down towards the grate, and so promoting their thorough mixing. The absolute necessity of a sure acting feed pump has led to the use of a specially designed

one that will always be sure to act. This result is obtained at the cost of a large amount of steam for the pumps, but the result is so necessary that it has been said that the pump is what makes the boilers.

The accessories to this boiler are so numerous that they make a considerable addition to the machinery of a vessel. The number of separate machines that are required to make this boiler act, at all in a safe way, leads to an exaggerated amount of repairs, and the care of the steam producing plant becomes a more difficult matter than that of the engines." * * * * * * * *

We imagine that makers of tubulous boilers in this country will "get around" many if not all these impediments. In fact we never could see the adaptation of Bellville boilers to marine purposes.

TOP HEAVY WAR VESSELS.

Whether this country, like both France and England, is to go through the evolution of top-heavy war vessels remains to be seen, but two precedents, first in England, and now again in France, should stand as a warning against altering or increasing the armament after a vessel is laid down by the naval architects.

The *Engineer*, London, in their issue of June 7th last, No. 2,058, has a "leader" on this subject worthy of careful reading, not a technical one, but historical mainly. The following quotations show the drift of the remarks:

"A ship is designed to carry a fighting mast; some one thinks that if one mast is good two must be twice as good. The single mast was to carry one fighting top, but on the same principle that the masts are doubled the tops are doubled, and finally each mast becomes a great steel tower. In the same way a ship is designed to carry a 6-inch gun, but a 7-inch gun accomplishes at a target trial much more than the 6-inch gun. At once the armament of the ship is altered, and so on—we see with what result. The great defect of the French ships is probably that they are too narrow. It will be remembered, no doubt, that in Nelson's time and before, the French ships of war were always better sailors than ours. They had, as Mahan among many others points out, better lines than our vessels. The French naval authorities of the present day have followed, *mutatis mutandis*, the example of their predecessors, and have endeavored to obtain speed by reducing beam. All might have been well but for the insane policy of permitting those responsible for the offensive power of the ship to overrule the naval architect, and pile on the top of a hull, already tender enough, weights which could only have been safely carried by ships with four feet or five feet more beam. * * * * * * * *

There remains something to be said, a word of warning to be

spoken, about the enormous quantity of top hamper with which only too many of our fighting ships are oppressed. We have deck-houses and bridges, and boats and cowls. These would be converted in five minutes by machine and quick-firing guns into matchwood, probably the matchwood would be set on fire. Ships of war must carry boats, numbers of boats, but why should not folding boats of the Berthon type be used, which could be stowed below when going into action? The steam launches being of steel would simply be blown to bits, they could not burn. No wooden structures of any kind should be permitted on the upper deck. The Eastern war has driven that lesson home. As to the funnels it is clear that with anything like a smooth sea, and a moderate range, machine guns could cut these off pretty short. The cowls and ventilators would be reduced to small scrap."

These two quotations are not directed to the same branch of the subject. The first ends a review of British and French experience in altering ships as they are being built, which, as our readers will remember, came near spoiling some British ships, and has spoiled some French ones. The second quotation is directed to a question often asked, namely, what is to become of the spar deck hamper in close battle, and will a ship be in a workable condition when this large amount of apparatus is shot away? Some of the modern battle ships have the hamper of a small village above the protected line.

LONDON ELECTRIC STATIONS.

Mr. Guido Semenza, an Italian engineer, who recently visited London, contributes to *L'Elettricista*, an article on London electric stations, that will have interest to our readers. We quote the article in part, from a translation in *Industries and Iron:*

"Take any station in London. It does not matter which, they being nearly all moulded on the same pattern.

An unimposing entrance — a small passage between some houses — and at the end, the central station. There is generally also a covered passage just large enough to allow a coal wagon to pass. To the left, for example, there is the coal shed, and to the right, slightly raised from the ground, is the boiler-house. 'Boiler-house' is as yet a euphemism; it is nothing but a series of Babcock and Wilcox boilers running the length of the passage, and with only a few yards between the front of the boilers and the wall. Continuing in the same direction, the engine-room is reached. Parallel to the wall, which separates the engine-room from the boiler-house, are fixed half a dozen, or more, Willans engines, direct connected to an equal number of heavy bi-polar dynamos, both engine and dynamo

being on the same bed-plate. On the wall facing them is the switchboard. Only a poor light enters the engine-room, and it is with difficulty that one can pass between the engines and the wall, or between two engines.

On the occasion of a visit of this kind, the engineer-in-chief generally takes the visitor in hand, and replies to any questions that may be put.

'Why do you adopt inexplosible multi-tubular boilers, which are not so efficient as others — for safety no doubt?'

'No; a good boiler should not become overheated. These boilers may, perhaps, consume a little more coal than others, but they are not so costly, and occupy a small amount of space; besides they can soon be got under steam!'

'And the Willans engines. Do they work well?'

'Very well. There is no fear of accident with them, and if, accidentally, something does happen to go wrong internally, no damage is done externally. In such a case, no time need be wasted in trying to discover what has happened. It is only necessary to telephone to the makers, and the damaged engine is replaced by another one in a few hours. They have, however, the fault of being somewhat bulky.'

'Bulky!'

'Certainly, when it is remembered that a Parsons' steam turbine will replace four of these engines.'

'Yes, but what about the efficiency?'

'Very little is known about that, but it would appear to be fairly good when arranged for condensation.'

And so on to the end. It is easy to quickly grasp the fact that the principal points to which attention is paid are — space occupied and safety of working. The space taken up by the engines increases the price of the land, this in the centre of a populous district being an important factor. As regards the second point, the English have to be sure of maintaining a regular supply under all circumstances. To give an idea as to the extent they go in this direction, it may be mentioned that in certain central stations, the dynamos, or at least two of them, are not self-exciting, the exciting current being taken from the supply mains, this being done because the self-exciting machine is considered to occupy too long a time in starting."

THE KEELEY MOTOR.

Keeley motor literature, like Carlyle's *Sartor Resartus*, has to "clip itself to pieces and struggle out through courageous magazines," and with a woman for the principal essayist. Her contribution on this subject in the *Arena*, for August, 1894, has by chance just been read, and having some knowledge of Keeley and his earlier

engines and discoveries, we read the *Arena* article with much interest.

It contains for premises, as do all other writings on this subject we have seen, certain facts or phenomena that are not proved and not known; for example, a pressure of 2,000 pounds per inch, which means nothing without movement. A common vice will exert 2,000 pounds per inch, or ten times this if the area of pressure is small enough, but that is not energy or power.

About 1872 we were in company with some others invited to see what was perhaps Keeley's first "motor." It was an ingenious "catch," called to mind again by Prof. Morton's recent description of the Redheffer machine, of which an account was printed in No. 84 of this Magazine.

The Keeley machine consisted of an induction nozzle of small diameter through which the service water was passing under a pressure of about 60 pounds per inch, at a velocity of about 3,500 feet per minute. An induced current of air was driven forward by this jet and applied on a piston of six to eight inches area, moving at perhaps 100 feet per minute, and the wonder was to see a piston and small engine of this size driven by the water that would pass through a "goose quill."

The machine was well made, and nearly frictionless, because it would stop if touched with the hands, and in the construction was seen the cunning of Keeley. He did not use a fly-wheel with a continuous rim, but a number of weights on the ends of spokes or arms that were dangerous to touch when in motion.

This lasted a time, and then came the impulse engine, which to any one versed in hydraulics was merely a case of "water hammer." If any one will arrange a long pipe filled with water under pressure, and then release and suddenly stop the flow, the blow or "ram" given is as the gravity of the water multiplied by its velocity, and if this is repeated, taking up the force against an air cushion, the effect is cumulative, like driving a tight piston, or a spike with a hammer, and the resulting pressure will be what Keeley attained. This second machine, also made at Philadelphia, we did not see, but give the explanation of a friend, who is a scientific man of high attainments who had himself made similar experiments.

From that on we have kept clear of the Keeley matter, but always noting the standing of every one who professed faith in his schemes, and have yet to know or hear of any person whose judgment and opinions were entitled to much weight.

ACETYLENE.

In No. 833 of the Journal of the Franklin Institute, for May last, will be found the text of a lecture by Mr. T. L. Wilson and Dr. J. J. Suckert on "Acetylene" that gives the whole history, nature and significance of this new source of light. Mr. Suckert in his remarks says:

As an illuminant, acetylene surpasses in lighting power and economy all other illuminants known; when burned at the rate of five cubic feet per hour it produces a light equal to 250 candles, whereas the best illuminating gas made from coal, or water gas, rarely exceeds twenty-two candles for each five cubic feet burned per hour. Your Philadelphia city gas is rated at from nineteen to twenty candles. Acetylene gas will, therefore, produce twelve and one half times more light if the same quantity be consumed, or 1,000 cubic feet of acetylene gas will give you the equivalent in light power of 12,500 cubic feet of your city gas, it has, therefore, twelve and one half times the value. To illustrate more fully the difference we will first pass your city gas to the tube attached to this stand, and ignite the gas as it issues from the burners, we then conduct acetylene gas to a similar row of burners, and light these, the contrast, as you will perceive, is almost marvellous."

The gas is generated by exposing the crystals of calcium carbide to water in a very simple apparatus. The material is a product of lime and carbon treated electrically, and the lecturer claimed that one electrical horse power would produce twenty pounds of calcium carbide in twenty-four hours. He also stated that it was his opinion that by using lime stone and coal dust for materials, calcium carbide could be produced at $5.00 a ton, at which rate the cost of light by the acetylene method would not be but a tenth as much as the same light derived from common gas, or direct from hydro-carbons.

Calcium carbide consists of 37.5 parts of carbon and 62.5 parts of calcium, and the gas or acetylene contains 92.3 parts carbon and 7.7 parts hydrogen. This gas, now attracting wide attention, is the first among many inventions for a long time that promises a marked economy in chemically-derived lighting and heating agents.

A company in New York are, it is said, preparing to make calcium carbide at Niagara Falls on a large scale with a view to its sale as an illuminant, but if reports are correct in respect to the scent and odor given off it will be hard to introduce the light in confined places, however cheap it may be.

A TRADE TO FALL BACK UPON.

The above title in one of our exchanges brings to mind a story told of Stephen Girard, the Philadelphia millionaire who founded Girard College. He had counting houses in different parts of the world with headquarters at Philadelphia, where young men entered as clerks had hopes of promotion by being sent to other places as partners or to participate in profits.

One young man who had served a good many years, and become impatient, finally ventured to call on Girard in his private office, and tell him that he, the clerk, wanted to better himself, and start in some business on his own account, but wanted Girard's advice.

The old man thought for a time, and then said: "I think you had better learn the cooper's trade." This caused consternation. The young man said nothing, but went home to consult his friends, who knowing the old man's peculiar methods advised that the suggestion be followed, and the young clerk was entered in a cooper shop as an apprentice, where he hammered and shaved for two years, and again called on old Stephen to say the business was learned.

"Make me a couple of barrels and bring them around here," said Girard.

The cooper clerk went back to the shop, made a pair of barrels, put them on a barrow, and himself wheeled them around to Girard's office and sent in for him.

The one-eyed millionaire came out, examined the barrels carefully, called for a "driver," knocked off the top hoops, took out a head and examined the croze, put the head back himself, and called the maker into the office.

"Now," said Girard, "I want you to go to the West Indies and conduct my business there. I never start a man but once, and if you fail you will have a good trade to fall back upon."

We do not know if the story is true, and do not care. It is useless, and conveys no idea of the facts as they exist. A man who fails in a counting room does not go to making barrels. If he did it would not be "falling back," on the contrary might be falling upward, as barrels are made now-a-days. A trade to fall back on is a myth. An education or an accomplishment in some art might do in the story, but not a skilled trade. Indeed, the latter requires continual practice, and there is no room or chance for any one to "fall back" into such pursuits.

CAST CRANK SHAFTS.

The following reprint of a letter by Mr. Williams, will have an interest to many of our readers. There are some strange things respecting cast iron, which sometimes finds its way into places where only fibrous material is thought of.

In the case below it must be remembered that the lines of strain are more direct than is possible with built-up work, consequently comparison is not direct as between the different materials.

Editor American Machinist:

"The article entitled 'The Evolution of a Crank Disk and Shaft,' page 470, June 13, 1895, recalls to my mind what evidently was never known by the writer of the article, although sufficiently published and exhibited to be considered as public knowledge, viz.: that, in fact, Wm. Emeory Mills, of the New York Engine Co., built engines with shaft, balanced crank disk, crank pin and eccentric, a single casting of cast-iron.

They were of the side-crank type, of large diameter and short journals, and sand cored entirely through the shaft, disk and pin, and were found to be stronger than solid.

This was prior to successful steel castings, although Mr. Mills contemplated using steel castings, if steel should be sufficiently perfected for the purpose.

About 50 agricultural engines were built with these shafts, which received the usual treatment of unskilled management, runaways, tip overs, rolling down embankments, striking bridge abutments, etc., breaking fly wheels and other parts, but never a shaft broken, worn out, defective or unsatisfactory in any way, the working qualities proving superior to wrought-iron.

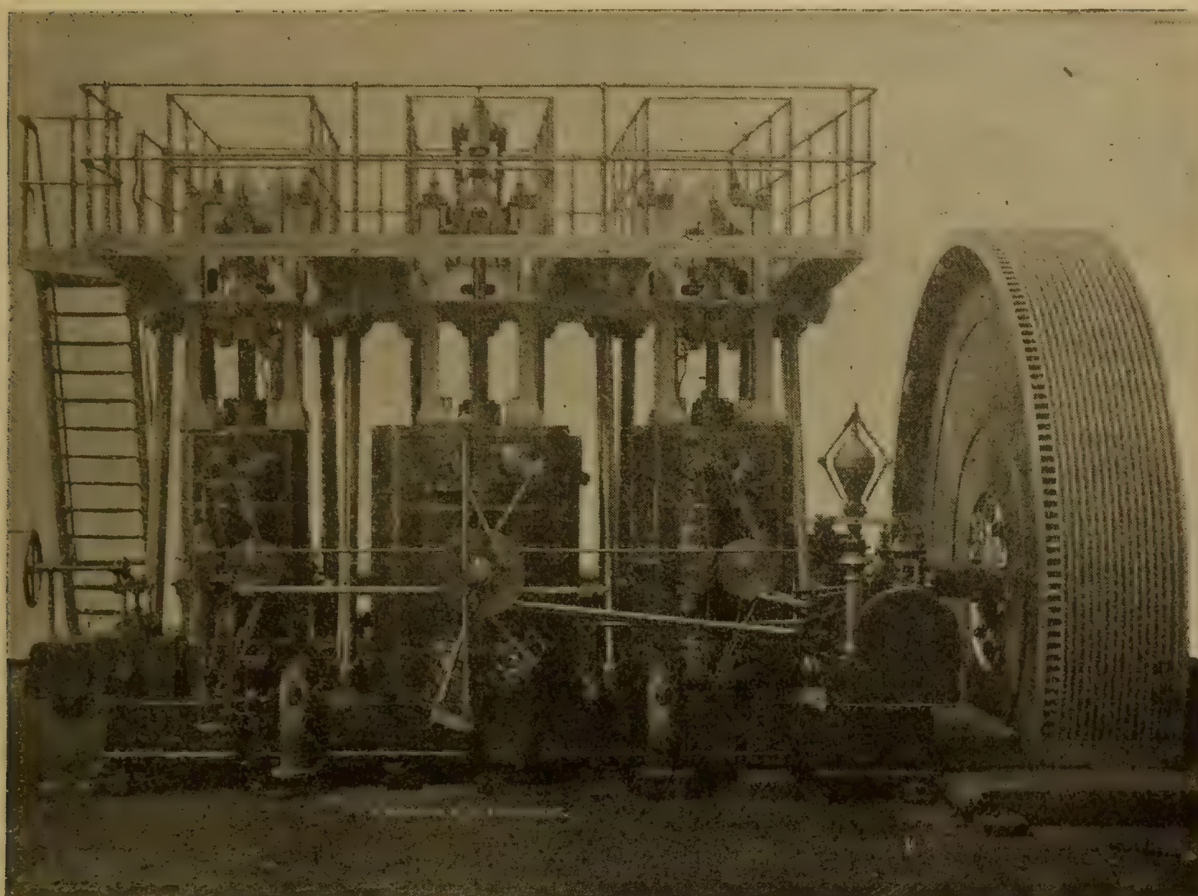
Some of these engines were finished by the Fishkill Corliss Engine Co., and one was in the New York State agricultural engine test in 1877, taking first prize for power and economy over all, including the engine which took the Centennial prize.

These engines were run with 120 pounds of steam, and at 325 revolutions. They had piston valves, automatic by varying valve travel, but fixed eccentric.

Mr. Duning, of Geneva Central Iron Works, made some engines with cast shaft and disk, but inserted pins.

It follows, therefore, that no fear need be entertained of the success of cast-iron shafts without steel core (which probably lays loose in a chilled hole) excepting the 'evolution.'"

Buffalo, N. Y. F. R. WILLIAMS.



TRIPLE CORLISS BEAM ENGINES.

MESSRS. W. B. THOMPSON & CO., DUNDEE, SCOTLAND.

In our issue for July, No. 84, there was mention of a triple beam engine made at Dundee, Scotland, for a cotton Mill in Bolton, England, by the firm above named, also the result of some tests made by Mr. Longridge, of Manchester, England, showing a very high efficiency of the engine, a front view of which is shown above. The engraving is made from a fine photograph sent out by the firm, and is but one out of several showing the engine in various positions, but is quite sufficient to convey an idea of the general design.

The remarkable feature of this engine is the beam arrangement, and this is quite enough to warrant this second notice and comments to follow. A second feature is that the engine was made in Scotland, and furnished to an English city where mill engines of the highest type are made, and for use in a country which is preëminent in this line of engineering, the Lancashire district, where the best type of mill engines are now and always have been made.

Beam engines are called "old fashioned," even to the point of ridicule. Their use on the North River and Long Island steamers, and on ferry boats generally in this country, has called out a good deal of adverse criticism from English steam engineers, who have contended that American practice was half a century behind, and that beam engines were superseded in English practice long ago, but like some other superseded inventions they come back again when innovations have run their course.

As remarked, the popular idea of beam engines in this country, as well as in England, is that they are nearly obsolete, and have given way to better forms of construction, which is not true, and never can be until the same functions are attained in other designs. We do not mean for all uses, but for a large share of cases.

The things especially referred to are that the reciprocating elements of beam engines are in equilibrium, balanced on a scale beam, so to speak; the piston is suspended in the cylinder, so as to wear equal on all sides, and the links or connections make only a slight angle, so there are no considerable lateral strains. The same remark applies to the crank connection, which is long without a corresponding waste of room.

The various pumps are worked directly from the beam with only motion rods for gearing, and the machinery, as a whole, occupies a long narrow space, fore and aft in vessels, is set on edge, so to speak. The principal strains are taken up on vertical lines, falling in the plane of best resistance, that is, normal to the foundation.

The engines shown in the engraving were driven for trial at more than one hundred revolutions, one hundred and twenty-five as remembered, when loose and resting on blocks, as the picture shows. Their working rate is much less, and the foundations required are not more than one half as expensive as they would have been to accommodate directly-connected engines. This latter feature is however due in a great measure to the triple beams and connections, with consequent balancing in a great degree of the reciprocrating strains.

The valve motions, as will be seen, are extremely simple, and the main parts, requiring care and adjustment, are all within easy reach. The cylinders stand on the floor, and an attendant can go all around them. The convenience is remarkable, and is not attainable in the same degree by any other arrangement.

The Anaconda Co., at Butte., Montana, require at this time some ponderous winding engines, and the contract has been

awarded to the Union Iron Works, in this City. The designers have adopted the beam method. These engines, now nearing completion, are well worth a visit to see, and there is no doubt whatever that the working results will confirm the wisdom of the designers in adopting the working beams. This fact we mention to show that in this country we have not abandoned beam engines, and are not likely to in cases where endurance and convenience are made the first considerations.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

By the courtesy of the Secretary, Mr. R. W. Pope, we have received Vol. XI of the Transactions of this society for 1894, containing the papers and discussions at the annual meeting in May, and in eight intervening monthly sessions, making up a volume of 938 pages, finely printed, and bound as a library volume.

Of the technical papers contained it will be useless to express an opinion, unless it be to say that the change from elementary to detail treatment of electrical problems is here strongly marked. We have from time to time during the year, or upon the appearance of the papers, noticed them in "INDUSTRY," and on the present occasion intend to present some notes on the rise and progress of the society, which formed the theme of President E. J. Houston's inaugural address at the annual meeting, Philadelphia, May, 1894.

Perhaps no society of like nature, or any society with scientific and industrial objects, has been so rapidly developed. The organization was made in 1884, and was in a sense the outcome of the Electrical Exhibition, held at the time in Philadelphia, and from 250 members in 1888, the enrollment at that date, the number has increased to 924 in 1895. The work done has been progressive in the same degree, and while the institution is by no means so extensive as the British one of like name, the character of the work done, and its value in a practical way, will compare favorably with its predecessor.

Prof. Houston in his address gives a diagram comparing the British and American societies, showing that the former was organized in 1873, and in 1893 had reached a total of 2,150 members. It must, however, be remembered that the British society is drawn from an empire of 325 millions, because the membership to a great extent is colonial, embracing Canada, Australia, the Asian, African

and other dependencies, so that comparison between the active work of the English and American societies is by no means in proportion to membership.

There are electrical associations of note, and comparable, in France and Germany, also smaller or less pretentious ones in various other countries, but the main work of progress centers in this country, England, Germany and France.

President Houston in mentioning the part that the American Society had taken in electrical progress during recent years spoke of many notable inventions. Among them: high frequency discharge; apparatus for welding metals; power transmitting apparatus, including mining, transportation, the distribution of power, and so on, in all of which this country can claim a first place.

The address has for its most conspicuous feature, continual allusion to the universality of research and progress, marking a change in the engineering arts that might well be imitated in commerce, and while no such claim appears in the address, we think a fair inference is that scientific matters are just as much ahead as they are universal. The requirements, as well as natural conditions, vary greatly in different parts of the world, affording different fields and opportunities for research conducted by different methods, so that electrical progress has become an universal whole.

The American Institute of Electrical Engineers has wisely and in consonance with its liberal policy in other matters, set a very important example in splitting itself into branches that meet simultaneously in various parts of the country to discuss the same papers and problems. This is rendered necessary by the impossibility of attendance at the monthly meetings beyond a radius that time and expense will permit, so that it is in a sense but one meeting, necessarily divided into sections. It is a method that needs extension to a number of other societies that may well profit by the example. Suppose for example, that at a meeting in New York, the attendence should reach 500 members, how could discussion be attempted under such circumstances?

The subject of general indexes, as presented by Professor Shepardson, at the regular meeting in November, 1894, and the copious discussion that followed shows the interest taken in what may be called the coöperative idea in scientific research. Development of the same spirit is seen in the *Journal of the Associated Engineering Societies*, and in the monthly annotations of technical literature now found in several leading serial publications.

LITERATURE.

The Evolution of Industry.

By Henry Dyer, C.E., M.A., D.Sc.

Honorary Principal Imperial College of Engineering, Japan. Life Governor Glasgow and West of Scotland Technical College.

[Macmillan & Co., Publishers, New York and London.]

Prof. Dyer is in one sense an evolutionary type of the self-made man, not perhaps in the same sense as Hugh Miller, or George Stephenson. Dyer started as a boy in the workshop, and by his industrial perseverance acquired the means and the influence to enable him to study the best systems of mechanical engineering under the most famous masters of the art, such as the Napiers and John Elder, of Glasgow, and by gaining a Whitworth Scholarship he was enabled to study the scientific laws and theories under the ablest and most famous professors of the sciences in Great Britain.

When the Kingdom of Japan founded the Imperial College at Tokio, Professor Rankine, of Glasgow, was asked to choose the first principal, and his choice was Henry Dyer. Rankine was one of those great souls who looked upon a trust as a sacred obligation, and he felt himself duty bound to select the best man that Great Britain could produce, and Dyer was that man; and how well Dyer has succeeded in teaching the Japanese youths of twenty years ago in the mechanical arts and sciences is shown by these same youths who were taught under him, proving as they have done, the conquerors of China.

If any man is suited by training and education to write with authority on the great problems of economic or progressive science it is surely such a man. His whole life has been devoted to the study and practice of the educational methods best suited to increase the usefulness of industrial pursuits.

As the leading member of the Glasgow School Board for several years (since resigning his position in Japan) he has devoted himself to the work of correlating the school and college systems of that great city, so the one is now a stepping stone to the other, and all are bound by an indissoluble bond of unity.

In the preface to this important and useful work on industry, Prof. Dyer puts the problem of the industrial age in the words of M. De Laveleye, which is really putting it into a nut shell:

"The message of the Eighteenth Century "to man was: Thou shalt cease to be the "slave of nobles and despots who oppress "thee. Thou are free and sovereign, but "the problem of your time is: It is a grand "thing to be free and sovereign, but how is "it that the sovereign often starves? How "is it that those who are held to be the "source of power often cannot even by hard "work provide themselves with the neces- "saries of life?"

This reminds me of a conversation I heard once between two Irishmen in Scotland, forty years ago. They were both laborers, but one had the enviable position of having been in America, and although the boys used to say that he could know very little of America, because when he found to his disgust that there were laborers in New York as poor as himself he made his stay so short that he had not time to look what o'clock it was.

However he passed as an authority, and when he was asked to explain how in a free country there should be any poverty: "Well bejabers," he said, "freedom is held so sacred over there that if you have not got a pair of boots to put on, you are at perfect liberty to go without them, and if you have not got a shilling to buy a dinner, nobody will compel you to eat it." "But," said one of his audience, "what would they do to you if you were to eat a dinner without paying for it?" "Bejabers," he said, "you go and try," and that settled it.

In the introduction Prof. Dyer draws an analogy between mechanical energy and industrial energy, and points out the important fact that if in mechanical science useful work cannot be performed without effort, that not only is perpetual motion impossible, but that the highest efficiency we can get from the most perfect motors falls far short of perfection; so in industrial science, we must not expect to create wealth without work, nor need we expect the full amount of the work to be represented in the wealth

produced, and as there are many forms of energy in the physical world, so we may expect to find many methods of creating wealth in the industrial world. Industrial energy is not necessarily manual labor, but has for its factors intellectual and spiritual effort as well, he says:

"There is a tendency at the present day "to attach undue importance to mechanical "work, and to forget that intellectual and "spiritual work is often the most important. "Even what is usually considered wealth "is not simply the result of manual toil, or "of even social labor, but of both of these "multiplied by ability, a fact which ought "to be carefully remembered when discuss-"ing the methods to be followed in social "reform."

He says that where Adam Smith uses the word labor as the principal factor of wealth production, he did not mean manual labor alone, but mental labor as well, but that recent writers, such as Henry George, say: "Nature gives wealth to labor, and to nothing but labor," such is a retrograde opinion culled from the canonist doctrine of the Middle Ages, when the only two factors o wealth production was land and labor, when "God and the laborer were the true lords of all that serves for the use of man, all others are either distributors or beggars." But Dyer says that such a socialistic doctrine is not true. He says that labor without proper direction is more likely to decrease than to increase wealth. He says that the definition of useful worker must be made wide enough to include all who render efficient social service, whether by pen or pick.

I think the author might even go farther and make the definition of a *useful worker* as one who manually or mentally produces a profit by his own work. It is not enough that he should produce as much as pay for its production; what would you think of a wealth-producing machine which costs as much to run it as it could produce, there should be a surplus.

The first great social problem then is to so employ mental and manual labor so as to produce a surplus. The second is to so distribute this surplus as to prevent individual poverty, and at the same time assist in producing an accelerating surplus. These are the two fundamental problems of social life and industrial science.

We heartily agree with the author when he says:

"Ability and energy ought to be better "remunerated than common-place efficiency "and certainly more than stupidity and "laziness."

I think it is a pity that the word power should be used by the author as a rate of doing work. I know that in mechanical science Watt introduced the term horse power to mean the time or rate at which a horse is supposed to do work, being 33,000 foot pounds per minute. But the prevalent idea of power is the reservoir of force or energy, that which is exhausted by the work done, unless replenished by the energy produced. I am pleased, however, to see that the author considers evolution as a mere process, and that there is a power behind humanity and all things, which is not exhausted in any of its forms, as shown in evolution.

He also agrees with Le Conte and the most advanced thinkers of the day by acknowledging that man has the power of modifying the laws of natural evolution, and by interference can hasten or alter the process. After showing how competition and machinery has cheapened production without increasing profits, and reduced labor without increasing the happiness of the laborer, he proceeds to show the advantages to be gained by intelligent unionism as a means toward the much more efficient principle of conciliation and conciliatory boards.

He traces the evolution of that radical function through its various stages, from the days of Queen Elizabeth until in its latest integration it has produced coöperative stores, conciliatory boards and arbitration between capital and labor. To the Professor all these agencies are by evolutionary process, tending toward a socialistic union, which will insure as high a degree of individual liberty as is found most compatible with the well being of the State.

In page 281, after criticising Mill and others regarding the importance of individual liberty, he says:

"But, after all, it must be remembered "that real liberty is to be found in the con-"ditions which enable a man to make the "most of himself. What is too often called "liberty at present does not do this. With "not a few it means liberty to starve; with "many it means liberty to engage in a fierce "struggle with their fellows, not only for "wealth, but even for existence. With a "considerable number it means liberty t

"exploit the community for their own sel-"fish ends. With a small but increasing "number it means liberty to devote a great "part of their energy to advancing the wel-"fare of the community or of humanity, "for altruism becomes an impelling and "governing power in human conduct when "it is not swamped by conditions which "tend to the encouragement of selfishness. "They have become convinced of the fact "that our individualism has lost us our "individuality, and they strive to obtain "sufficient independence to regain this."

Prof. Dyer holds similar opinions with Prof. Le Conte on the problems of the future in economic socialism, and shows how the use of scientific methods should be gradually but carefully adopted; how we should aim more at removing the resistance and reducing the friction, which at present prevents the vital principle of altruism from working with efficiency. The dominant idea is to give this great christian principle an open field, and the solution of the great problem of everlasting happiness for the human race will soon follow.

This volume, we hope, will only be the beginning to a much more extended treatment of the same and allied subjects by the same author, than whom there is no writer better able to do this great subject better justice. Whilst his sympathy is with the working classes, from which he has sprung, his experience and his training have enabled him to comprehend, and not undervalue, the importance of scientific skill and the necessity of well-directed capital as mighty factors of stability in the fabric of economic socialism. This book is suited alike for the library of the merchant as the book-rack of the workman, and neither manufacturer nor artisan should be without a true knowledge of the important facts and principles therein demonstrated.

ROBERT STEVENSON.

The absence of the Editor at the end of the month causes the omission of our usual notices of new books and other publications, except as to Mr. Stevenson's able criticism of Professor Dyer's work on the "Evolution of Industry."

LOCAL NOTES.

Absence at the time of opening and down to publication of this number prevents notice of the Mechanics' Institute Exhibition. Next month the subject will have its proper place in "INDUSTRY," and, as we hope, with the commendation promised by the methods set forth in the prospectus.

Mr. B. S. Pague, former officer in charge of the U. S. Weather Bureau here, has issued an interesting table showing the number of clear and cloudy days in various American cities, the percentage of sunshine, amount of rain and mean temperature. In 1893, which was normal or average, there were 80 cloudy days in San Francisco, and 285 clear or partly clear days, which disproves the common opinion of ocean fogs and overcast weather here. Boston, New York, Philadelphia, Cleveland, Cincinnati and Chicago, average 127 cloudy days or 63 per cent. more than San Francisco. For this Coast Los Angeles heads the list for clear weather, having but 44 cloudy days for the year, but Denver, Col., excels with but 39 days, and Santa Fe with only 31 days. Portland, Or., naturally heads the list for overcast weather with 180 days of clouds and 185 days of sunshine, a division into two equal parts nearly.

The Cahill & Hall Elevator Company, of this City, have in contemplation an enlargement of their works, which is a healthy sign for these times. The company have during the last six years done much to advance the art of "hoisting and lowering" in our commercial buildings, and have been among the most active in this line of business, having fitted out many of the principal public buildings here. As the erection, millwright work and plans have to be made here for elevator plants, it is naturally a manufacture that should be wholly carried out at home, with enough competition to keep practice up to the highest state of the art. No city is better served in this respect than San Francisco, which is the birthplace so to speak of "elevating" people, if we include the hill cable ways, which are only inclined elevators, and the company above named are now applying nearly the same methods in "vertical travel."

An engineering reader sends the following:

To the Editor of "Industry." *Sir*:— Noticing your comment upon the brake power upon the electric cars in this City, in the July issue of your paper, I am led to ask why the roads do not use a track brake, in addition to the regular wheel brake? It would be simpler than the mechanism suggested and fully as effective. In one of the "hill cities" of the Mississippi Valley, where we had 8 per cent. grades, I equipped the cars with such brakes, and there has never been an accident during the five years the road has been in operation. Your statement that the "armature is a fly wheel" is correct, but one that very few engineers seem to realize; let me suggest further, that the whole car, with its heavy motors, moving at a rate of 10 to 15 miles an hour, is a "projectile" of no mean momentum, and that it will take considerable power to stop, or control it.

It is a curious thing that with all the writings, protests and complaints, there seems to be no investigation of the causes of danger in the electric urban railways. The whole matter is capable of analysis, and with this, remedies will appear.

Electric elevators are just now in a state of vigorous evolution. *Cassier's Magazine* for August contains a long article on the subject, by Mr. Joseph Sachs, describing the practice of various makers, in no case, however, as we think, equalling what is done on this Coast. For example, they have winding drums in all but one case, and in that Armstrong sheaves, both systems being open to objections mechanically. The Cahill & Hall Elevator Company here employ a traction system, corresponding to the cable railways, that cannot overstrain the ropes, bends them in one direction only, and compensates for their gravity. Just at writing this we examined a report by the owner in Los Angeles of an electric elevator by the company above named, stating that the current used for the work was less than in any similar case in that city, and all the operating qualities are so perfect as to leave nothing to be desired. The Company are erecting several of a similar kind in this city.

We expect before long to re-publish an essay on gas engines, that will include all that may be said of the subject at this time, but there is one point worthy of immediate attention on the part of the various makers here, and that is the trend toward the use of oil in its fluid form, and dispensing with extraneous igniting devices. We do not contend that every

one engaged in making explosive engines should change their plans to meet this tendency. Too much haste in a new art often leads to retracing one's steps, but every one should keep informed, and watch the circumstances. For the first time in thirty years the German makers seem to be behind in the race, or in other words are not leading in this branch of engineering work, and there are strong indications that this country is to become the foremost field for new inventions. The making of the Holroyd–Arkwright engines by the De La Vergne Company, of New York, will, no doubt, stir up a new advance in oil engines.

The Vulcan Iron Works of this City, have recently been much extending their saw mill branch, a specialty at these works that has cost a good deal to establish. By judicious advertising, the company have extended their business to Mexico and Central America. Present orders are being executed for Guatemala. For some strange reason orders for saw mill machinery are frequently sent East, when the price for the same work is less here, and in some cases orders given at the East have been filled by the works here on account of Eastern firms. A fact like this, which is easily verified, would be valuable in the hands of the Manufactures' Association. There is enough saw mill work here to keep the whole force of the Vulcan Iron Works employed continually, and there is a possible adaptation of the work that should command the trade if there was only fair play in the matter.

The Nevada County Electric Power Company has a fertile field to operate in from its Grass Valley plant. Within a radius of nine miles are more than sixty separate mines to which power can be supplied, many of them only a few miles away. Not only this, these mines being so near together have exhausted the timber for fuel, or at least have so increased the price that many are shut down for this reason. What the rates for power will be we do not know, but if reasonably sold, 4,000 horse power can be contracted. Everything depends on this, and it is too soon to estimate the price of power so derived, on any basis of general application. Like all other things the measure of price should be governed by the cost of production, but as the industry calls for special natural conditions that precludes competition, the price is likely to vary a good deal being as Adam Smith says, a question of "opportunity."

In Napa County the Supervisors have happened on a discovery that should be widely known. By wetting the public roads in summer they are saved from pulverization and destruction, so the repairing expense for the year is actually less than under the old system, that is, the work, repairing and watering, is less than for repairing alone. Sixty miles were watered last year, and Santa Clara County is fast extending the same system. This is an amazing fact. Hard smooth roads, no dust, no destruction of horses, harness, clothing and health, and at a "reduced cost." The saving in hauling will alone pay for the watering. This same scheme will apply to any of the main valley roads in California, and to think of it as a new discovery is humiliating. We have just driven 100 miles in this summer dust, four inches deep in some places, pulverized road metal of the best quality that the first rains will wash off and leave a surface as bad as the cobble streets of San Francisco.

If newspapers are an index to popular intelligence, San Francisco must sometimes get a low rating. One of them recently had an article on the cost of coal to consumers, the object of which was to show that tariff taxes were not paid by the consumer, and that a rebate of 35 cents a ton on imported coal had not lowered the price but had raised it, then adds:

"For this increase in price the retailers are not responsible, since they can get coal from the combine only on condition that they will retail it at not less than the prices named. The job has been arranged by R. Dunsmuir and Sons and John Rosenfeld's Sons, who control the supply of British Columbia coal, and who have adjusted some ancient differences in order to make more money for joint account out of the California public."

That is, if the Government tax is lowered, and the local combination puts on a still larger tax, then the tariff reduction is responsible for the increased price to the consumer, and this is in a leading journal. The question is, who is this written for?

The Valley Railway Company should not forget a considerable obligation that this and indeed all iron and steel using industries here owe to the Pacific Rolling Mills Company. To erect and maintain here a gigantic plant, such as the company have, with a prospect of having always some of their departments idle, or not

fully occupied, is a work of public spirit, and deserves all possible support. The steel plant there, that did the most successful work on the huge castings required for the United States war vessels built at the Union Iron Works, is not like a similar plant at the East that is put down with the idea of running all the time. On the contrary, the steel furnaces, among the largest of their kind, have to be held in a kind of reserve for emergencies, and it is provoking and unfair to bargain and cavil over a fraction of a cent on a pound when castings are required. A little "protection" is excusable in such a case.

Irrigation schemes in the Southwest are assuming gigantic proportions, if one can credit the reports that come to hand. The Pecos Valley, in New Mexico, is one of them. The main and lateral canals foot up 1,200 miles, and the impounding reservoirs have a capacity of more than six billions of cubic feet. The area of arid land to be reclaimed is rated at 400,000 acres, sufficient for 10,000 families. Settlers are now upon and occupy 75,000 acres, much of which is employed in producing lucerne or alfalfa. Such schemes are beyond comprehension when presented in figures and words. At San Bernardino, in this State, there is in progress a canal, that with its branches will foot up 600 miles, intended to water 200,000 acres on the Mojave plains, near Barstow. This scheme is by the Columbia Colonization Company, with which General O. O. Howard is connected. It is a wealthy corporation, with interests in the Antelope Valley, Colorado, and also has lands in Georgia.

From Arizona comes another scheme of irrigation. A canal to extend the whole length of Yuma County, the main stem 60 feet wide to convey 50,000 miner's inches of water, or 1,000 cubic feet a second, from Eureka Cañon, of the Colorado River, at Hinton's Island, crosses the Gila River on its course, and waters 80,000 acres of land, equal to 125 square miles. Mr. G. W. Norton, at Yuma, is the engineer of the scheme. These enterprises, if carried out, should furnish a useful and safe investment for locked-up capital in this country, that for many years past has of necessity been put into railways, built long before they were needed, and for competition purposes. Then again, if not carried out, as is probable in many cases, such abortive schemes destroy credit and confidence. We have mentioned only a part of the enterprises announced.

Comments.

Mr. C Baillairge, C. E., of Quebec, writing in the *Canadian Engineer* of the failure of the Bouzey Dam, in France, says:

"Now since a dam or other retaining wall will and does become, so to say, water-logged or saturated with moisture to the extent of — under the effects of frost and chemical decomposition — disintegrating the mortar, and reducing it to sand, as observed in hundreds of cases under similar circumstances, since it must and will come to be in 20, in 50, or in 100 years that the cementing material will have lost its binding qualities, and the masonry become reduced to the state of a dry stone wall; since this is inevitable, for a dam must or should be supposed to endure for all time or for centuries, like the pyramids, like the Roman aqueduct, etc., therefore must it be contended and admitted that while doing the best we can in the way of enduring cementing material, the dam or retaining wall should be built of such thickness that the binding matrix need not be relied on, and the mere dead weight of the masonry, as if a dry stone wall, made sufficient to stand the thrust of the pushing water or back filling, whatever it may be?"

The great problem now facing people of this country is what to do with the "water" or fictitious capital in stocks. The poor man who pays his nickel to ride on a street car gives half of it for service and half of it for fictitious capital, sometimes the greater share of it goes for "water." On some railways, the Redding and Missouri Pacific for example, three fourths of the earnings go to pay interest on a capital that has no tangible existence, and it is doubtful if the whole investment under corporate control in this country is worth one half of the rated capital. All this must be paid for by honest productive industry. When hard times come and merchandise sinks in value, these watered securities do not decline, but keep up their nominal value. This is the incubus that is crushing the life out of our agricultural and other industries. It is not the silver problem or hard times, it is what is called financiering. The man with a plow, plane or hammer cannot keep up with the man who has a pencil and no conscience.

We thought at first some good would come of the Horr-Harvey debate in Chicago, but that idea was dispelled as soon as a few comments appeared in the newspapers. These comments disclosed two

facts, unmistakably, there was no popular understanding of the issues debated, and that prejudice precluded fair judgment. We once heard a Jewish merchant say that the world was making good progress in all matters except political economy and religion. This was twenty years ago, and an observance since then has confirmed this view. In a little school book, written some years ago by Mrs. Fawcett, wife of the blind British statesman, the first question is: "If a boy breaks a window, is that a good thing for the glazier?" Second: "Is it a good thing for the community?" The authoress might have stopped there, because answers to these two questions are enough to exhaust what popular knowledge exists on the subject of economics.

We have not had time or fortitude to read over Judge Ross' decision in respect to the Wright Irrigation Act, but with every one else must deplore the consequences that may follow. The judge has, however, only laid down an opinion held by a good many more versed in the subtilities of "law as she is made." There may be no better way of carrying out corporate measures that effect the property of people without their assent, but we must not forget that such measures are often a serious infraction of individual rights. We have always believed that the power delegated to trustees under the Wright Law were far too wide, and that the checks were insufficient at this day of schemes to protect the citizens of a district. That the Act can be amended and improved no one doubts. It is the common history of all such important laws, and our opinion is that the principle or method should be extended if possible to all public works, including lines of railways. If the lands in a district were appraised, and the dissatisfied owners paid out, that might remedy the practical impediments that now appear.

In an engineering paper recently published we are informed that:

"Earth dams are most common, but are most liable to fail; if "water flows over the dam it is only a question of time before the "whole dam is swept away, therefore a sluice-way must be pro- "vided."

This kind of academic school-boy information is of no use, besides is not true in several of the statements. Earth dams are not on the whole, or in proportion to their relative number, the most dangerous. Every one knows that the water cannot be permitted to

spill over a common dam, and no one builds a common dam that way, but if he did and provided for the erosive action of the water, it is not "a question of time until such a dam is swept away." The La Grange Dam, illustrated in our last issue, is a spill dam not likely to be "swept away." The fact is if there was less literature on dams better ones would be made. The money element is the main one in dam building.

Prof. Thomas H. Huxley, the celebrated English scientist, died on the 1st of July, when 71 years old. He was like nearly all other scientific men of note, a medical doctor to begin with. No man in Prof. Huxley's position has so little regarded traditional ideas. He set out originally in all things that engaged his attention, not from egotism or confidence in himself, because at each step he found error, and was bold enough to so claim before the world. He was in science like John Bright in politics, always saying and thinking simple things that seemed too elementary to engage a mind like his, but when he had finished, people were astonished to find themselves with new ideas of the subjects discussed. No one could say with such candor "I do not know." We do not accept the adulatory notices that claim his place will not be filled, on the contrary believe we are in the future to have hundreds of men who will follow his methods in the greater light, much of it shed abroad by his own example.

The recent advance in the rate of wages in at least four hundred establishments in this country is a circumstance without precedent. No one has ever before seen anything of the kind, and the causes are anything but plain. For three years past the country had been in the throes of violent labor disturbance, both work and wages being reduced from one end of the land to the other. The Carnegie and Chicago riots, and the great railway strike only a year ago, came near the borders of anarchy, and the revolt against corporate exactions had reached a limit, how dangerous no one may ever know. Now the question is, what has caused a voluntary increase of wages? It is an economic problem that is puzzling every one. That an increase of customs depresses wages is a fact based on the history of all countries, but that a slight reduction in customs tax and cheapening of material should so soon permit an increase in the wages element does not seem possible. Let us hope it is a sense of justice and fairness on the part of employers.

The annual and never-ending cup-race between American and English sailing yachts is to come off this year again. We say "yachts" with a reservation, because the vessels prepared for the occasion are better named as "racing machines." It is a harmless and interesting amusement for those who have the required funds to spend, but it is not navigation, or closely allied thereto. It is hard to understand how resistance is avoided and sail stability secured by such hulls as those of the *Valkyrie* and *Defender*, yet the fact must be accepted, although it upsets all previous notions of naval architecture. We have been comparing, and find that after all the models of these vessels are but an exaggeration of the Swedish sailing boats, not of size, but of the principal features, such as the deep short keels set abaft, and the hollow side lines. The *Vigilant*, after some recent alterations, has made a run, it is claimed, at the rate of 18 miles an hour from Newport to Bristol, 13 miles in 45 minutes. The center or lee board, now gone as an element in these boats, shows how a mistaken idea can last for half a century. Neither of the new vessels will have this attachment.

The technical matter dished up in newspapers has of late increased in quantity and decreased in quality. The *Maritime Register*, of New York, thinks steam ships will be driven by electricity, that is, the paraphernalia of an electric outfit should be substituted for the engine crank, or somehow sandwiched in between the generating elements and the screw. Another paper describes how one of the Herreshoffs "back geared" the tiller shaft of the *Defender* so as to get a "quicker movement" and at the same time "more power." One must conclude that technologists, engineers and mechanics are not so badly off for something to do, otherwise they would be employed by sensible editors who would submit such matter for correction or suppression.

It is not very long since New South Wales, Australia, with some other countries, was held up as a "frightful example" of the evils of State ownership in railways, but now after passing through a financial panic such as has not been exceeded in history, the management of the railways in New South Wales contrasts in a very striking manner with the free system of this country. During the last six years the New South Wales lines have paid profits into the treasury amounting to $11,060,000. Last year the earnings per

train mile were about $2.00, and the net profits 85 cents, so the working expenses were less than 60 per cent. of the gross earnings. The capital on which the earnings are made is about $215,000,000, on which the present returns are 3.46 per cent., notwithstanding the deficit of some non-producing lines is figured into the account. If such a result as this is due to State control we could stand some of it here.

Some of our readers no doubt wonder why "INDUSTRY" does not take part in the copious discussion on American and European tools and machines that has been going on in the technical journals for some time past. The reason is that such discussions are of little use, and the premises in nine cases out of ten have no foundation in fact. The merits of machines and tools are relative, and the opinions commonly prejudiced. We for many years exported American implements into Europe, and have discussed this subject of national peculiarities and merits of machines and tools with people from all parts of the world, and for all kinds of purposes; also have furnished American tools to go to many countries under diverse uses and conditions, and long ago reached a conclusion that there are no impartial opinions among makers, and seldom among users. We have our own opinions in respect to many machines and processes, and the adaptation of American and European implements. It is as honest and impartial as effort can attain, and is just enough to discern that most of what is written on the subject is wide of the real facts, and that no one person is competent to publish opinions that apply generally.

The best way to judge of machines and processes is to divide their product by wages, but even this will not do in all cases. In one works we know of, vice screws are cut by chasing with single tools in lathes. This is in one of the most advanced works in the world. One man with a machine could cut twenty screws to one done on a lathe, but the lathe is the proper thing, because the screws are cut by "premium" apprentices, and are worth less after finishing than before. The owners are paid for the privilege of cutting the screws. It is a suitable job for training men in lathe work, and is kept for that purpose. The loss is a fee for education paid by the apprentices' parents. This is not commendable as a method, but is a singular case of fact. We have seen a steam

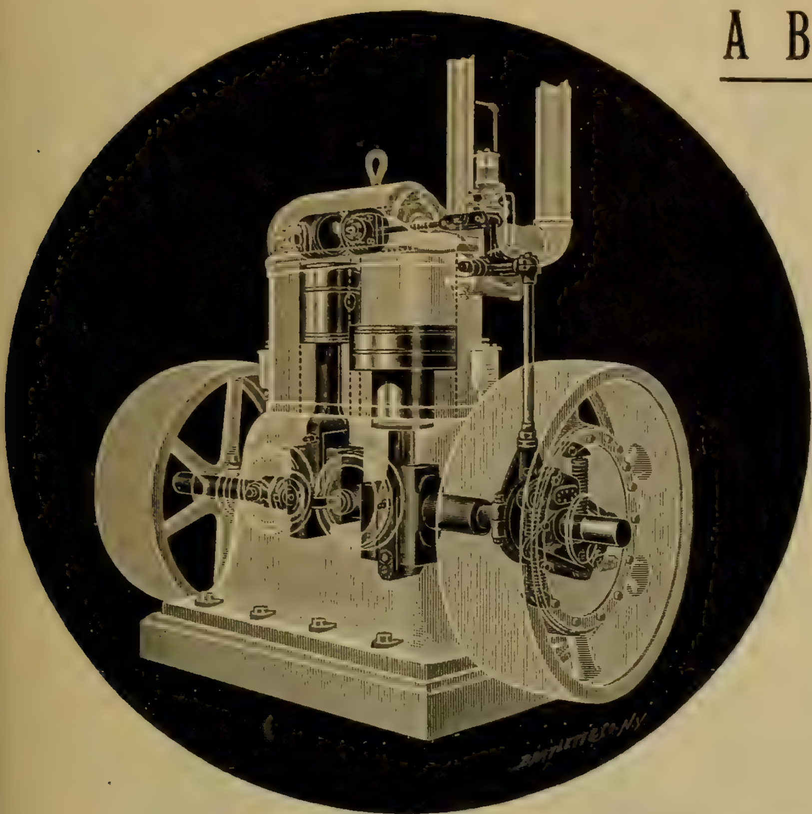
pile driver beaten by hand driving, and a marine engine made where there were no machine tools but small lathes, drilling and planing machines. It was done by blocks and fixtures, all right for one engine, but all wrong for a dozen engines, but how many could understand that?

Mr. William Cox, C. E., of Stapleton, New York, has established a new manufacture, and, as we may say, a new branch of science, in logarithmic scales and apparatus for performing mechanically nearly all kinds of computation required in engineering work. Among the objects attained by these "computers" is the determination of the flow of water; horse power of water wheels, engines and boilers; the flow of steam and gas; mensuration of solids, such as earthwork, and the strength of beams and girders. The following explanation is given in the author's circulars:

"These computers are mechanical devices by means of which the different formulæ to which they are adapted can be almost instantaneously solved. They consist of two parts, a foundation plate and a revolving disc, upon which are set off logarithmic scales corresponding to the various factors of the formulæ, so that by turning the disc around, and bringing the value of two of these together, the value of the fourth factor is at once seen opposite the third one. When a formula consists of five or six terms, an extra piece in the shape of a segment similarly graduated revolves about the common center. With these computers hours of tedious computation may be avoided, errors eliminated, and the solution of a problem obtained with far greater appreciation of the effects produced by a slight modification of any one of the factors than is possible by working out arithmetically any number of suppositional cases by means of the formula."

The price of these computers is uniform, ten dollars each. Orders for them can be sent on Mr. Cox's account to the publishers of "INDUSTRY."

Those who think that a coin is not a commodity will receive an object lesson if they go to a British bank to deposit gold. It is dumped into the scales and weighed, the same as ingots would be, or is treated in the same manner as iron, copper or lead. There is a margin for "wear," and if this is exceeded the mint stamp is of no more good than a fancy print on a light roll of butter in a Philadelphia market. As a matter of fact coining everywhere is no more than measuring or marking the weights or quantities. In former



A BUSINESS PROPOSITION!

☞ Any purchaser, so desiring, is welcome to have his engine tested by his own expert at our shops before shipment, and may accept or reject the engine on that test before incurring the expense of installation.

THE WESTINGHOUSE THREE ENGINE TYPES

COMPOUND 5 to 1,000 H. P. — Unequaled simplicity, high efficiency and moderate cost.

STANDARD 5 to 250 H. P. — A high-class automatic, endorsed by thousands of users.

JUNIOR 5 to 75 H. P. — A durable and efficient Automatic Engine at a low price.

Catalogue on Application.

THE WESTINGHOUSE MACHINE CO.

PITTSBURGH, PA., U. S. A.

☞ SELLING OFFICES.—26 Cortlandt St., New York, N. Y. 171 La Salle St., Chicago, Ill. 53 State Street, Boston, Mass. Westinghouse Building, Pittsburgh, Pa. 210 Drexel Building, Philadelphia, Pa. 37 College St., Charlotte, N. C. 21-23 Fremont St., San Francisco, Cal. 259 Main Street, Salt Lake City, Utah. Wonderly Building, Grand Rapids, Mich. All Offices of the Westinghouse Electric and Mfg. Co., and all Foreign Countries.

BERLIN LONDON ST. PETERSBERG VIENNA

Siemens & Halske Electric Co.

Pacific Coast District, 508 California St., S. F. Head Office, Chicago, Ill.

Yard Telephone No. 67 Office Telephone No. 5153

CALIFORNIA

IRON and WRECKING CO.

Successors to HENRY J. ROGERS & CO.

Submarine Contractors, Wreckers and Divers

IMPORTERS AND WHOLESALE DEALERS IN

CAST AND WROUGHT IRON

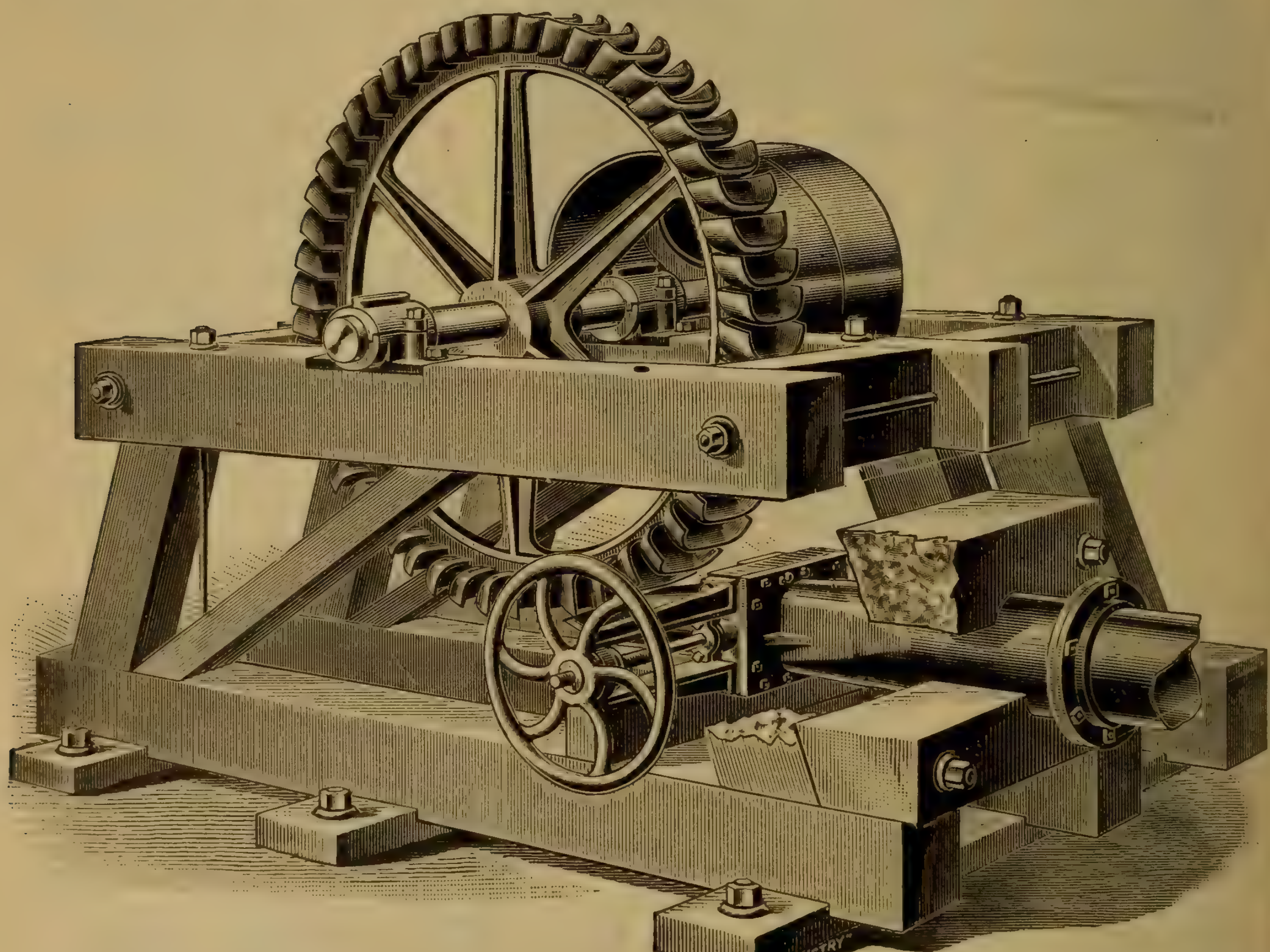
IRON SCRAP, and other METALS,

Second-Hand Machinery and Water Pipe,

Iron for Smelting and Reduction Works

638-640 Second St., San Francisco

THE
KNIGHT WATER WHEEL



The drawing above shows one of Knight's Standard Water Wheels, of which there are more than 450 in use in California alone. These wheels are made from 2 feet to 6 feet in diameter, from 10 to 1000 horse power, and adapted to all heads and to all purposes. Their first cost is less than one half as much as pressure turbines, and the expense of maintenance is not one fourth as much. Circulars with full description and particulars sent free.

KNIGHT & CO.

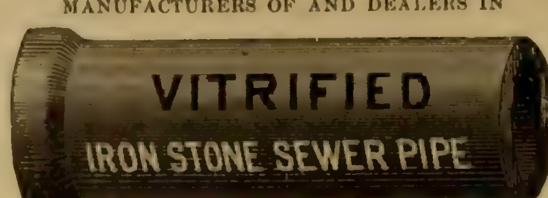
SUTTER CREEK, Amador County, Calif.

RISDON IRON WORKS, San Francisco Agents.

N. CLARK & SONS

MANUFACTURERS OF AND DEALERS IN

CAPS AND TOPS



FIRE BRICK AND FIRE CLAY

Water Pipe Chimney Pipe

17-19 SPEAR ST., SAN FRANCISCO

times, we are informed, land leases were drawn at Philadelpia making the rent payable in "ounces of pure silver," so as to provide against the debasement of coins then going on in the German States and elsewhere. "German silver" is a good example of making money by law. It was the custom to call in and recoin the money with less silver in it each time, the Crown pocketing the difference. This was royal stealing, but the stamp it was soon found had no respect. We, ourselves, remember having once received a pound or so of these German silver coins in exchange for half a sovereign at Hamburg.

The *Iron Age* commenting upon profit sharing some time ago said:

"Profit sharing is not a panacea for allaying labor troubles. It is not capable of universal nor even of general application. The few instances in which it is successful, or apparently so, do not prove that other employers will find it beneficial to them. Such a scheme will flourish if all the conditions are favorable, and especially if the originator is gifted with a peculiar genius for philanthropic work, but not if it is entered upon as a cold, mechanical, mathematical business proposition. As well might the success of certain communities holding property in common be cited as proving that the true way of solving the problem of life is to form such communities everywhere. Innumerable unsuccessful efforts have been made to establish other communities which were failures because the organizing talent was lacking. It is thus with profit sharing. Other requirements are necessary than executive ability, and these requirements are not common."

This is undoubtedly true and understated. The most unfortunate phase of the system is that it may some time add fresh stimulus to discontent. It is intensifying the dependent system, and not possible with intelligent men where the capital is mainly "water," as is the case with many enterprises where labor disturbance exists.

ENGINEERING NOTES.

Now that the matter has been better explained it seems that the failure of the Niagara Power Company to obtain a charter in the City of Buffalo for distributing motive power by electricity was due to the fact that the Company would not agree to a time or price for the supply, which is certainly a reasonable objection to granting a

charter. A concensus of present opinion in respect to electrical transmission is that five miles is a commercial limit in the present state of the art. This may not apply to exceptional cases, as in California or Switzerland, where the power is from water in inacessible places, and where there is practically no competition with steam power, but to districts like that around Niagara, and in other large cities similarly environed. There is also a rapidly increasing opinion among responsible engineers that air transmission will in many cases be cheaper and better, because there is less danger, the losses are fast disappearing and the air is directly applicable to various uses requiring rectilinear motion, as in elevators and the like; also is directly applicable to rotary motion by means of impulse wheels.

The fact that air as a medium for power transmission can be applied to turbine motors, common steam engines, *en situ*, and to produce directly rotary and rectilinear movements, will soon become facts of great importance in transmission. The dynamite gun plant here will no doubt afford some data bearing upon this point, because in long transmissions, as in the case of electricity, high pressure will be necessary. An engine now made at Rome, New York, operates with air at 2,000 pounds per inch, heated and expanded down to the atmosphere. We expect to farther notice this engine and the principle on which it operates. The main interest in power transmission lies where mountains of culm are thrown away, within reachable distance of cities, and there seems no difficulty in the way of transmitting power by means of air at high pressure, unless it be in the apparatus at each end.

The French invented the velocipede in its original form, and are busy in inventing self-propelled road carriages, which this far have not acquired a distinct name. A gentleman who recently inquired into the matter says there are hundreds of these carriages in use in France, and they are employed to a great extent by country physicians. The engines are driven by "spirits of petroleum," the speed is eight to ten miles an hour, and weigh 1,000 to 1,500 pounds, to carry two to four persons. The supply of fuel is enough for fifty miles. It is reported that a carriage company in Paris has ordered two hundred of these vehicles for passenger service. There has recently been a race from Paris to Bordeaux and back, about 750

miles, with these vehicles, twenty-seven of which were in competition; sixteen petroleum engines, seven steam, two electric engines, and two petroleum bicycles. One petroleum carriage reached Bordeaux in 10 hours 32 minutes, and returned to Paris in 49 hours. Three others came in later, but only one steam carriage made the round, and it was one constructed about twenty years ago. Twelve carriages reached Bordeaux, and eight got back to Paris within 100 hours.

At Berne, in Switzerland, where power transmission and connected subjects have received more attention than in any other country, there has been erected a very complete compressed air plant for operating street railways. There are a series of cylindrical receivers under the car platforms, twelve in number, 18 inches diameter, to hold 65 cubic feet of air, which is compressed to 588 pounds per inch. This air in its passage to the engines goes through a deep stratum of water and steam contained in a vertical cylinder or receiver, the air taking up heat and moisture before it reaches the working cylinders, which are only 5 inches bore, 8.5 inches stroke. It is to be noted that there is just now a considerable extension of air driving for street railways. A new plant of large size has just been put down in France on the Mékarski system, and in this, as in Berne, the whole work is of the most permanent character.

One of our exchanges tells of the "largest derrick in the world" at a granite quarry in Vermont. The boom is seventy feet long, and the structure made of steel. This may be the largest derrick in Vermont, or east of the mountains, but taking the square of the reach as an exponent of size it is only a third as large as one made about ten years ago by Messrs. Knight & Co., of Sutter Creek, for the Arroyo Seco Mine, near Ione, California, the boom of which is 120 feet long. Not only this, the grab tackle was operated by steam, and the spoil was deposited 40 to 50 feet above the working level. We do not remember other dimensions, but there were all the required motions for swinging and discharging the gravel, which was dug up by the steam-driven jaws without quarrying. But even this is not the largest derrick. One recently built here for dredging purposes has a boom 120 feet long to swing in a circle of 200 feet, with massive proportions that would dwarf the one in Vermont.

We some time ago mentioned the Steamer *Anthracite* that visited New York about twenty years ago, and have had some inquiries relating to the matter. Mr. Joseph R. Oldham, of Cleveland, Ohio, in the *Canadian Engineer* for July last answers the inquiries very completely as follows:

"Up to the year 1850 the load on the safety valves, as a rule, did not exceed 10 pounds per square inch. Ten years later the corresponding boiler pressure was 20 pounds. In 1865 it had risen to 30 pounds. In 1872 the load on safety valves of a number of typical steamers was 52½ pounds per square inch, but in 1874 a mighty leap was taken by the late Dr. A. C. Kirk, of the firm of Robert Napier & Sons, who designed the triple-expansion engines of the *Propontis*, which were worked by the Rowan water-tube boiler, with about double the last pressure mentioned. A few years later several small schooners, notably the Steamer *Anthracite*, which was constructed under the superintendence of the writer, were fitted with the Perkins engines and boilers, working at about 300 pounds pressure, but such high pressures were rapidly abandoned, and in 1891 the average was 158½ pounds. Steam pressures are now rapidly increasing, and it may be that before many years such pressures as the *Anthracite* carried with her Perkins boiler will be the rule rather than the exception."

Mutations in the engineering arts are novel sometimes. The French, who invented and introduced turbine wheels, have erected at Morlai two American inward-discharge or, as they are called in France, "centripetal turbines." A drawing and description of these turbines is published in the *Genie Civil*, of June 29th of this year, written by Mr. Albert Mutin, C. E., the designs corresponding to the usual practice in this country. In looking over the drawings, which are given in full, it is easy to see why the centripetal system has recommended itself in this case. There was a large volume of water to be used at a low head, of less than two meters, and other types of wheels could not have been made at less than double the cost of the American type. The wheels were made by a firm who are successors to Fontaine, a celebrated maker of turbines.

The De La Verne Refrigerating Machine Company, of New York, have begun the manufacture of what is called the Hornsby-Akroyd oil engine that possesses several peculiar features worthy of mention. At the rear end of the main cylinder is a combustion chamber, a kind of extension of the cylinder, communicating by means of a contracted neck. The oil is injected into this combus-

tion chamber by means of a pump, and is immediately volatilized by reason of the heat, but is not explosive, because too rich, or lacking the required mixture of air. As the main piston approaches the end of the cylinder the contained air is forced through the passage between the cylinder and combustion chamber, where it mingles with oil vapor up to the point of explosion, and is automatically ignited accordingly, just when the piston has completed its stroke. The gases are driven back through the connecting passage into the main cylinder, impinging against a stratum of air in front of the piston, preventing the high heat common in gas pistons. Regulation is performed by diverting and returning the oil not required, the supply pumps working constantly at one rate. This seems a very complete method for such apparatus.

According to Sullivan's *Manual of Hydraulic Engineering* the loss by friction in circular nozzles is in terms of the head, roughly, one per cent., diminishing as the diameter or volume discharged is increased. For example, the loss of head given for 101.20 is 1.20 feet; for 404.80 is 4.80 feet; for 809.60 is 9.60 feet, and so on. A table is made out for reference based on the flow, being computed at $\sqrt{2gH}$ in feet per second, or $\sqrt{64.4 \times H}$, which is the same as multiplying the square root of the head in feet by 8.025, the common method. All this is useful to know, but is not precise when there are so many qualifying conditions as to the form and surfaces of nozzles. An example worked out for a cast iron nozzle, 8 feet long, 10 inches diameter at one end, and 1½ inches diameter at the discharge end, shows a loss of about twice the amount above named, and this is as much as can be assumed for common practice.

It will not be a very wild prediction to say that in a few years more, locomotive engines will be nearly all fitted with piston valves. The English locomotive makers and superintendents seem to be fast moving toward this method, and such prominent authorities as Mr. Worsdell, of the North Eastern Railway, and Mr. Johnson, of the Midland Railway, have appeared as advocates of piston valves for locomotives. The Baldwin Locomotive Works, at Philadelphia, employ piston valves for the Vauclain compound engines, which, so far as known, have never caused any difficulty, and when the heaviest and most abused stationary engines made, those for heavy

rolling mill work, are arranged with piston valves it seems that all limits are removed. These valves have the important advantage of being in equilibrium as to steam pressure, and afford a length of steam port not possible with a flat valve. All that has been wanting for thirty years past has been to gain for common piston valves the endurance of common steam pistons.

We sometimes hear it said that the old Cornish standard for pump duty was 70,000 foot pounds for 112 pounds of coal, but this is far from correct in respect to the best engines. In a public test made in 1835 with the Fowey Consols' engine, in Wales, the duty was 148,936,170 foot pounds per cwt. (112 pounds) of coal, work never exceeded except with some recent engines in this country. That same year, 1835, the East London Water Works sent a skilled engineer to examine the engines in Wales, among them the one named, which he found raising water at the rate of 111,061,333 foot pounds with 112 pounds of coal. The engine cylinder was 80 inches bore, stroke 9 feet 3 inches. The engineer, Mr. Wicksteed, found another engine giving out a duty of 140,484,926 foot pounds, consuming 1.57 pounds of coal per horse power per hour. In this case the cylinder was 50 inches bore, 8 feet stroke, lift 535 feet, boiler pressure 40 pounds, reduced to 30 pounds at the engine. These astonishing results will be found in a report of Mr. Wicksteed published in Volume I, Transactions of the Institution of Civil Engineers, London.

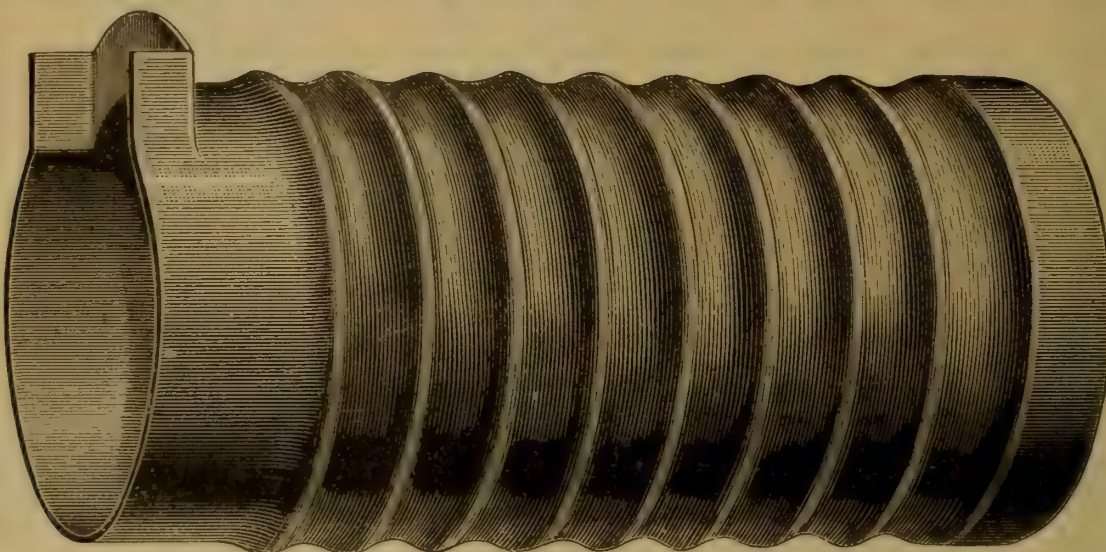
On the Western plains it is becoming common to construct wind wheels on the plan of turbines with a horizontal axis, exposing the side above the axis to the wind, which is received on curved vanes, and discharged below at the rear. This is a "Mortier" fan reversed, and has a good many elements of common sense about it, but it is not new. Taking the broad subject of utilizing fluids, a common wind wheel is a screw propeller reversed, that is, the vanes operate in the same manner, but no one thinks of making a water wheel in that manner, and if they did a very low efficiency would result. A water current wheel is the nearest analogy to a wind wheel, and the new wind wheels described in our contemporaries are merely current wheels on the Poncelet principle, and if the makers will study water wheels of this type they will find all the required data for constructing "Jumbo" wind wheels.

MORISON SUSPENSION FURNACES

FOR LAND AND MARINE BOILERS

— ALSO —

CORRUGATED FURNACES



Uniform Thickness Easily Cleaned

UNEXCELLED FOR STRENGTH

SOLE MANUFACTURERS IN THE UNITED STATES

THE CONTINENTAL IRON WORKS

P. O. Station G. BROOKLYN, N. Y.

INCORPORATED 1866

CHARTER PERPETUAL

Insures against Damage to Property, Loss of Life, and Personal Injury

CAUSED BY

STEAM BOILER EXPLOSIONS

J. B. PIERCE, Secretary
J. M. ALLEN, President

ABSTRACT OF STATEMENT
JAN. 1, 1895

Cash Capital,	$500,000.00
Total Assets,	1,955,255.24
Surplus as to Policy-Holders,	693,726.15

PACIFIC COAST DEPARTMENT

MANN & WILSON, General Agents

J. B. WARNER, Chief Inspector

306 Sansome Street - San Francisco, Cal.

The Editor of "INDUSTRY" having successfully disposed of a problem in incubators, and another one on acetylene, was brought up with the following: What is the coefficient of flow in a ditch measured by the surface velocity? He talked about vegetable growth, roughness and other things, suggesting 75 per cent., which is perhaps an average, but since then has come upon some late experiments in Holland, where the velocities and water were carefully measured, giving a coefficient of 60 to 65, which is no doubt as much as is attained in California ditches in the mountains, where the sides and bottoms are commonly rough, and is a good deal more than in ditches lined with vegetable growth. The mathematical determination of water flow in ditches is of little practical value, because of their being no rules for roughness that can be applied. It is like a supposed case of pipe flow we heard submitted to a practical man recently, who gave the amount as "none," and he hit the circumstances exactly, in a practical sense.

A firm of machine-tool makers at Keighly, in England, have made a distinct improvement in what are called horizontal boring machines. These machines can seldom be kept constantly at work boring except in large shops, and it takes very little change to adapt them to both turning and milling. As a rule combination machine tools are inexpedient, and not recommendable, but this is an exception, because the turning and milling attachments do not interfere with or much modify the boring functions, especially as in the present machine the whole is made exceedingly simple, involving only a longitudinal and cross feed of the table, and a face plate to go on the main spindle. A fault we see in the machine is a want of power in the driving gearing to turn pieces as large as the machine will receive, but this is a matter easily remedied, and would be an improvement even for boring purposes.

Last month there was mention in these notes of a hoisting works in Hungary where a speed of 1,700 feet per minute is attained. Mr. Thomas J. Barbour, of the Risdon Iron Works, in this City, writes as follows in respect to American practice:

"We note in "INDUSTRY," of August, 1895, you make the remark that you are not aware of the speed attained by the hoisting engines in the copper mines of Montana. For your information

would state that the writer, together with Mr. George Ames, of the Union Iron Works, and General Manager Couch, of the Boston and Montana, were hoisted out of the Lewiston shaft last June, six hundred feet in fifteen seconds, or at the rate of twenty-four hundred feet per minute. This is regular hoisting speed, and would state that the load is usually that of a double-deck cage, with two 1¼ ton ore cars, and they slacken but little when hoisting men. It may be that they hoisted us a little faster than the regular speed, but in hoisting ores this speed is continuous. I will state that they use flat rope, winding the same on a reel, one turn on top of the other. Their rope is usually four and one half inches wide by half an inch thick, and weighs about four pounds to the foot. If it would interest you as to the sizes of the engines we would be glad to give you information on this point. We are now building Captain Couch a hoist for his mines in Mariposa County, which will certainly hoist at the rate of two thousand feet per minute."

We are also informed from another source that at the C. & C. shaft of the Consolidated Virginia Mine on the Comstock Lode, in Nevada, a similar or even greater speed is maintained, the distance of 2,500 feet having been traversed in less than a minute.

In various discussions respecting the employment of electric motors for main-line service on railways there has not yet appeared much light or promise in so far as principles or methods, and the operative conditions have not been reached. Mr. H. W. Leonard has proposed a method of maintaining the efficiency of a motor under varying rates of speed, requiring, however, a triple capacity motor for that purpose. On short lines having regular service it seems possible to perform the service by means of electric motors, but it would be at the expense of conductive apparatus that could hardly be afforded for long lines, The French-Heilman system, on which two new engines are being constructed, is a whole plant loaded on a locomotive, and the electrical elements are only a medium for mechanical connection between a high-speed engine and the driving axles. No one can explain why this is any better than the ordinary reduction gearing that would not cost one tenth as much, and occupy space in the same proportion.

Mr. Charles Brown, of Basle, Switzerland, who designed the Heilman locomotive, or at least the mechanical elements of it, has been for some time past studying the adaptation of some kind of a motor to locomotive engines that will not have the limitations of a

reciprocating steam engine as to speed and disturbance. We are not aware of "where he is at" in the matter, but imagine there will not be much left of the problem when he has finished. In all schemes that involve carrying the generating apparatus, and with steam as the prime motive agent, the boiler seems to set a limit of speed, or rather the furnace does, and what is wanted is some less bulky element for fuel, and also for expansion. There are such elements capable of greater expansion, like hydro-carbons, naptha, alcohol or ammonia, but these cost too much. Engines with explosive action could not be directly geared, and are otherwise unsuited. A steam locomotive is, no doubt at this time, the best kind of "power factory" that can be mounted on wheels and carried over the country.

The C. W. Hunt Company, New York, are making a special kind of ropes for traction transmission, or rope driving, called "Stevedore," rope which from reports gives an unusual service for this kind of duty, which is severe as to abrasive wear, changing tension and flexure. The Los Angeles Electric Company have recently put on 3,000 feet of this rope, and we are likely to know soon what its endurance is. These remarks are preliminary to saying that common ropes, such as are usually employed, are not made for power transmission, but to withstand strain only, and the chances are that a very different "construction" is required in the two cases. A body to be bent having a neutral axis, as in the case of a rope, if twisted should have a short twist, or otherwise arranged to permit flexure without one side receiving all the strain. We do not know how this new rope is made, but there is certainly room for improvement on the common kinds.

We think it was Editor Miller, of the *American Machinist*, who some time ago said that as the steam people were trying to keep their engine cylinders hot, and the gas engine people trying to keep their cylinders cool, the two should be combined. The idea is not new. It was considered by Hirn years ago, and Prof. Jamieson has recently been trying an experiment in this line with a very promising result. In an engine of 136 horse power he introduced hot air on the exhaust side of the piston at a temperature between 500 and 600 degrees. The steam pressure was 113 pounds to an inch, and the steam consumption 31 pounds per horse power per hour. With the injection

of hot air the steam consumption fell off to 18.6 pounds. The gain must have been from an avoidance of cylinder condensation, and in this case very indefinite, as the 31 pounds of steam used will indicate. The steam was saturated, and 5 or 6 per cent. was lost in forcing the air, but the conditions were not unusual in common practice.

MINING.

NOTES.

The burning of a portion of the Utica mine, on the 22nd of July, and following, is one of the wonders to a surface man who can not conceive of dry timber beneath the ground. This mine at Angels Camp, in Calaveras County, is the largest gold mine in California, yielding in June, as was reported, $900,000 in bullion. In the last three years the clear dividends are set down at $2,640,000. The working force is 700 men, and $50,000 a month was being paid out for working expenses. The amount of ore crushed sometimes reaches 500 tons a day. The management during the disaster was highly creditable to the young superintendent, Mr. T. T. Lane, who at once made arrangements to flood the mine, for which purpose water at the rate of a million gallons an hour was poured down the shafts. Now comes the tedious and expensive process of pumping out and re-timbering the mine, which will be done with all possible dispatch.

Last month we mentioned a new amalgamating apparatus invented by Messrs. Brown, of this City, who have a laboratory at 710 Capp Street, where we witnessed the operation of the process some time since. The physical treatment consists essentially in setting a body of pulp in rotation by the action of a centrifugal circulating pump, so the material instead of being dashed against the plates in an irregular manner flows constantly over them without disturbance, and under circumstances that permits the most rapid and effective deposition on the silvered surfaces. The plates are curved concentric with the flow, and the column or mass is, when not in contact with the plates, broken up or stirred by the action of the pump. The plates can be lifted out any time for inspection or cleaning. The flow in the tank permits complete exposure of the solution to electrodes, and the whole seems to be a highly useful improvement in a very important matter.

Why the Anaconda Co., at Butte, Montana, one of the greatest mines in the world, has divided their stock by 25, is one of the problems of the time, and except in respect to taxation it is hard to imagine any harm that can arise from such a cause. The value of a mine, or system of mines, is dependent on the ore they contain, qualified by the cost of its reduction, and it may be that future prospects warranted a reduction of capital valuation, but a more likely reason is that the shares are to remain where they are now held, and not speculated in, if so their valuation is a matter of no importance except to the assessor. The wildest explanation we have seen, is that the property is to be sold. If there was some general law to remove the "water" from stocks, all other issues affecting business would be trivial in comparison, but this "cut" in Anaconda shares goes beyond water extraction, and comes very near extinction.

An object of the Houlahan dynamo that attracts non-magnetic metals, such as gold, silver, copper and lead, is to facilitate extraction processes, at least this is the only use that has suggested itself this far. The theory is that gold or silver when in the form of sulphides or chlorides, will be attracted and separated by magnets, or when passed between an armature wound on the Houlahan system and its magnets. There may be something in this, but a number of possible impediments have been suggested, and some time must elapse before the value of the scheme is known. Extraction processes have been such a fertile field for deception, that even a meritorious invention must run the gauntlet of suspicion, and perhaps receive unfair treatment. In this connection it must be remembered that Mr. Edison, who is an ingenious experimenter, has been over the ground, and that ten years ago there was talk of bonding the whole dump of tailings at Virginia, to be treated over magnetically by Edison's methods. His operations in New Jersey on iron ore have consumed fortunes, and are still in progress.

The unusual attack, it may be called, on the MacArthur-Forrest patent on the cyanide extraction process, in at least six countries, is we fear an exponent of the amount of common honesty incorporated in modern business. We have, as our readers will remember, for several years past argued against the extravagant claims set up by the company that owned the cyanide patents, but any reasonable person who has examined the evidence and opinions

of the court, in the recent trials at London, must be convinced that there was original and useful discovery on the part of the inventors, and even if this were wanting, the present wide use, and even the many suits in process would prove the fact of utility. The truth is, that at this day people do not want any less than what the whole machinery of the law can give them, irrespective of justice or fair dealing.

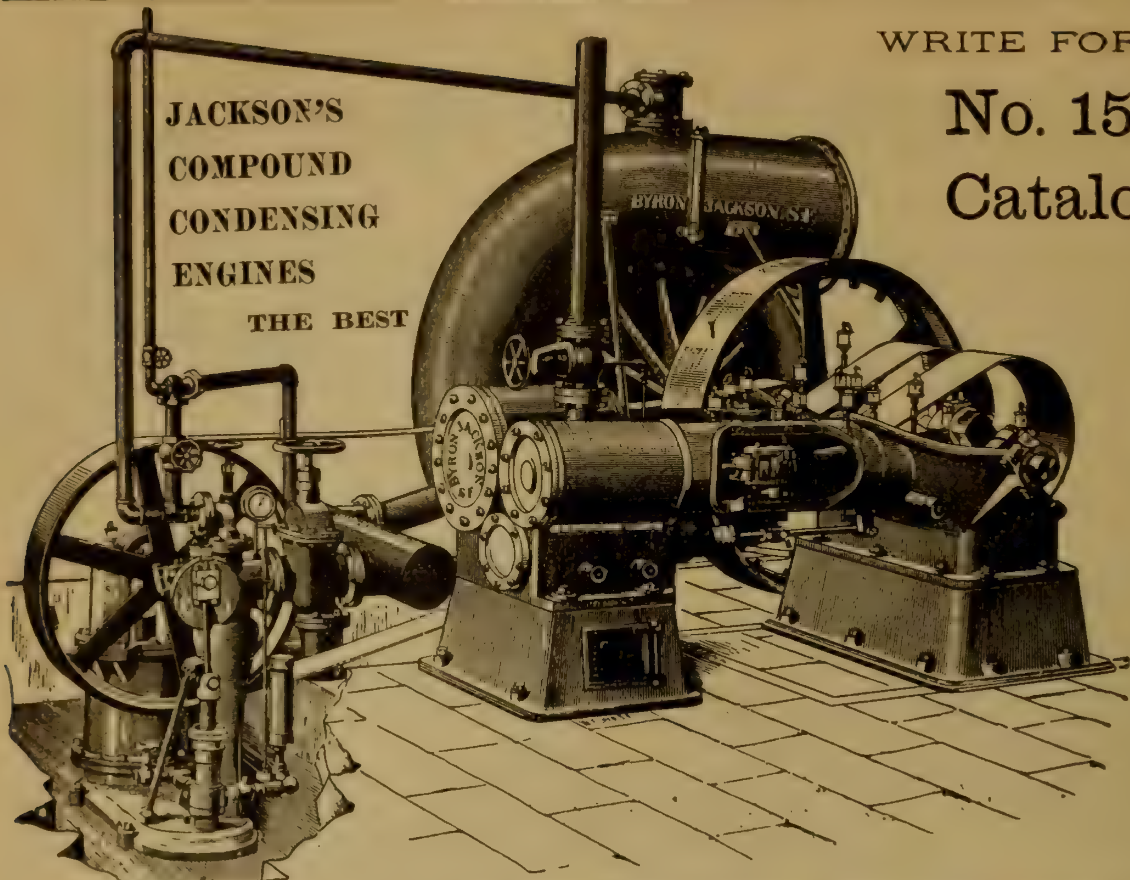
The Colorado Mining Bureau, at Denver, is one of the latest, and with its environment one would naturally expect some kind of useful departure in this Bureau business, but we note that among other functions there is to be a "museum," and a collection of bottles of potable water. Our idea of a mining bureau, which is no doubt crude, is a plain office room with storing space for the orderly filing of papers, the machinery of statistical records, and a list of mines with notes of each, such as is prepared at the U. S. Mint, but in this case for what purpose no one knows, because the facts collected are never given out in a way to benefit the mining industry. The Colorado Bureau is a disappointment and will no doubt prove a "bore" to all except those who participate in the appropriations. A responsible officer of mines without a "bureau," would lead to better results.

Mr. W. A. Clarke, of Butte, Montana, who has of the world's goods up to millions, is the owner of some mines at Jerome, Arizona, that in the opinion of a correspondent of the *Western Mining World*, will excel Nevada's Comstock Lode. These mines are 40 miles northeast of Prescott, in the Black Hills. One ledge is 1,200 × 1,000 × 350 feet, or about 16 million cubic yards, yielding $30 a ton. The mines are said to have produced 5,000 tons of copper and $1,600,000 in gold last year. Three hundred men are employed now, and the operations are being extended. The fact of personal ownership by one man gives color to the report of these mines, and there would be nothing anomalous in discovering ore bodies in the Black Hills of great extent and richness, but $450,000,000 worth in one mass is a severe strain on one's imagination.

There is a fair inference that river dredging for gold on this Coast has not been in the hands of or managed by good mechanics. This summer there will be a number of new attempts in California

WRITE FOR

No. 15 Catalogue.



JACKSON PUMPING PLANT FOR IRRIGATING AND RECLAIMING LAND.

Byron Jackson Machine Works

625-631 SIXTH ST., SAN FRANCISCO, CAL.

BUILDERS OF

COMPOUND CONDENSING ENGINES

AIR PUMPS AND JET CONDENSERS.

Pumps for Irrigation and Reclamation, Dredging, Wrecking, Mining, and City Water Works.

BOILERS

AND

ANY KIND OF MACHINERY BUILT TO ORDER

These pumps are intended for mine pits or deep wells, and will operate when submerged. The glands and inlets are sealed by water to give full power of the suction. The alignment of parts and for adjustments is perfect. The runner has balancing rings, and sustains the running weights by water pressure, and dispenses with a bottom bearing below the runner. All parts are removable from the top. These are all patented features, and found only in these pumps. The superior efficiency of these pumps has been demonstrated under all conditions of use, and they are sold subject to the broadest of guarantees as to efficiency and durability.

Jackson's Vertical Water-Balanced Runner and Shaft "Whirlpool" Centrifugal Pump.

rivers, and if the summing up in the autumn is not better than hitherto, the scheme had better be abandoned. The principal cause of failure has been in the employment of apparatus of the "rattle-trap" order, without either method or endurance. It is true that a good many unexpected impediments have turned up, but fifteen years should be time enough to learn the matter, and such dredges were tried that long ago, perhaps sooner. The Carson River scheme has not been creditable engineering, and in no case has a plant here been started and worked with regularity, as in Australian rivers. The new dredger fitted out here in July, may accomplish something, but it is doubtfnl.

The Consolidated Red Rock Mining Co., of Portland, Oregon, has a nominal capital of $11,000,000, and as reported 18 million tons of ore in sight, that will yield $8.00 to a ton in gold, also has a water power ready at hand, and if these and other statements are true it is an amazing mine. It consists of ten claims on a ledge 75 feet thick with a continuous face of 1,500 feet. As the operations this far seem to consist in making a road to the mine, we will keep watch of the case and see how much of the above description is borne out by future facts. This is one of the most pretentious in a large number of announcements of the kind coming in at this time. A discovery in Mexico and a mining scheme exceeds this one in extent. It means business of some kind however, and all promising news creates confidence in business resumption.

Miscellaneous Notes.

In Sweden the telephone service is the most perfect in the world, and the cheapest. There are twin wires used in nearly all cases, and the operators are better paid than in England where the rates are more than five times as much. The British tariff is the nearest to a commercial swindle of anything we know of in that country, and its tolerance is a wonder. A correspondent of the Glasgow *Herald* gave recently the rates from that city to principal points in the United Kingdom, the highest being for a conversation to London, $1.10; to Plymouth, $1.25; not falling below 60 cents to any principal city in England except New Castle, which is 35 cents.

The Swedish rate is in all parallel cases 6 pence, or 12 cents. Sweden has, among the countries of the world, gone on with the least oppression from trusts and combinations, and, as we may say, with none at all down to about 1880, when a customs tax was instituted, now almost done away with, however.

Ohio is the Canal State, the circumstances and topography favor canal construction. The State is comparatively level, or sloping from the Lakes to the Valley of the Ohio, provided with streams and level areas for the catchment of water. The Ohio Canal, Cleveland to Portsmouth, is 332 miles long; the Miami and Erie, Cincinnati and Toledo Line, is 291 miles long. These are the principal trunk lines, but other canals and branches must make up at least 1,000 miles, the extension through the Wabash and Ohio River Valleys to Evansville is 374 miles long. The great French Canal, du Midi, from the Atlantic to the Mediterranean Sea is only 148 miles long, but is large enough for boats of 600 tons burthen. The greatest canal of all is however the Imperial one in China, 1,000 miles long; Suez Canal is 88 miles long; the Calidonian, 60 miles. Holland had, until the opening of the North Sea and Baltic Canal, the largest canal in Europe, only 51 miles long, but 125 feet wide, 20 feet deep.

Now when no one talks of building ship and railway trains of aluminium, and there are no more processes to reduce it at "two cents a pound," the manufacture is proceeding on the normal lines of evolution. The largest works producing aluminium at this time are in Switzerland, where three tons a day is prepared at an expenditure of 4,000 horse power, derived from water power on the River Rhine. In this country the largest works are at Pittsburgh, operating by the Hall process, producing one ton a day, but this Company will soon begin at Niagara Falls, New York, to make two tons a day, and expect to increase the output to four tons a day. The whole product of the world in 1894 was a little more than one thousand tons, which shows just how far the metal has entered into the useful arts at its present price, which is about 50 cents a pound in this country, and 35 cents in Europe. It is commonly claimed that aluminium cannot be used for electroplating, but Mr. Darling, of Philadelphia, has settled that problem by heavily electroplating 100,000 square feet of metal at the new city hall in that city.

No. 87. OCTOBER, 1895. Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor Founded 1888. W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. OCTOBER, 1895. No. 87

MACHINES AND PROCESSES.

THEIR ECONOMY AND NATURE.

BY J. RICHARDS.

INTRODUCTION.

In 1832, Charles Babbage, Esq., A. M., professor of mathematics, at Cambridge University, in England, and the inventor of the celebrated *Calculating Machine*, prepared and published a very remarkable book, called *The Economy of Manufactures*.*

This work has been out of print for at least fifty years, but has remained for all this time one of the most thoroughly original books that was ever written on the subject of skilled industry.

The author, accustomed to mathematical analysis of all kinds of propositions, conceived the idea that the manipulative processes in skilled industry were capable of what he called "generalization," and thus resolvable logically, the same as forces and dimensions were mathematically.

It is not very easy to convey a clear idea of the scheme set forth in this work, because as remarked, no one has since proceeded in

*It is the intention to close the present treatise with various excerpts from Mr. Babbage's work, especially from the chapters relating to taxation, export, the division of labor, and other matters of an economic nature.

the same manner to analyze logically the nature of machine and other processes. The following quotation from Mr. Babbage's preface will indicate in general the objects he had in view.

"The present volume may be considered as one of the consequences that have resulted from the Calculating-Engine, the construction of which I have been so long superintending. Having been induced during the last ten years to visit a considerable number of workshops and factories, both in England and on the Continent, for the purpose of endeavoring to make myself acquainted with the various resources of mechanical art, I was insensibly led to apply to them those principles of generalization, to which my other pursuits had naturally given rise. The increased number of curious processes and interesting facts which thus came under my attention, as well as reflections which they suggested, induced me believe that the publication of some of them might be of use to persons who propose to bestow their attention on those inquiries, which I have only incidently considered. * * * * * * *

I have not attempted to offer complete enumeration of all the mechanical principles which regulate the application of machinery to arts and manufactures, but I have endeavored to present to the reader those which struck me as the most important, either for understanding the actions of machines, or for enabling the memory to classify and arrange the facts connected with their employment. Still less have I attempted to examine all the difficult questions of *political economy*, which are intimately connected with such inquiries. It was impossible not to trace or to imagine, among the wide variety of facts presented to me, some principles which seemed to pervade many establishments; and having formed such conjectures, the desire to refute or verify them gave additional interest to the pursuit. Several of the principles which I have proposed, appeared to me to have been unnoticed before."

This work, now sixty-three years old, and as remarked, out of print for fifty years, was prepared at a time when the industrial arts were unimportant, when compared with the present day, yet it is one of the most useful books ever produced, because leading up to a method of investigation which alone can give a full understanding of the nature and relation of skilled processes and machine effect.

The present treatise will follow a similar method, but over a narrower field, and will owe its inception to the *Economy of Manufactures*, not wholly however, because the writer in his *Workshop Manipulation*, published in 1875, adopted a similar method in an attempt to generalize certain machines and processes, without at the time knowing anything whatever of Mr. Babbage's book, which came to notice some years later.

In 1874, the British Association, in a meeting at Belfast, appointed a commission to investigate the means of teaching the physical sciences, and this committee, after carefully considering the subject say in their report:

"The most serious obstacle discovered was an absence in the "mind of the pupils of a firm and clear grasp of the concrete parts, "forming a base of the reasoning processes they were called upon to "study, and that the use of text books should be made subordinate "to an attendance on lectures and demonstrations."

These significant remarks in respect to pupils, apply the same to students and apprentices in their attempts to learn constructive processes.

For example, what interest can attach to the abstract fact that "the sum of the squares of the two short sides of a right angle triangle are equal to the square of the hypothenuse." It is a matter of no interest, and never can be until found in the concrete, and connected with some practical application.

The author when a boy, learned this theorem at school, and set it down as an ingenious puzzle to annoy young scholars, and had no conception of its use until years later when he found a joiner squaring a foundation, by "six, eight and ten." "That rule," said the joiner, "will square anything," meaning that a right angle or the corners could be determined in this manner. He added, that "twelve, sixteen and twenty would do," and this latter suggestion led to the discovery here of a purpose and practical use of the "forty-seventh problem."

In the text books, and in the teacher's instructions, there was no hint of the use of this fact of the relation of the squares of the sides of a triangle. This may not be the case now. The fact is presented in illustration, and it is complete in showing how computation is but an aid to the process of logical reasoning and learning.

The following from *Workshop Manipulation*, will further explain what is meant by concrete methods:

"A principle in mechanics may be known, and even familiar to "a learner, without being logically understood, it may be said that "both theory and practice can be learned without the power to "connect and apply the two things. A person may, for example, "understand the geometry of tooth gearing and how to lay out "teeth of the proper form for various kind of wheels, how to "proportion and arrange the spokes, rims, nave, and so on; he may "also understand the practical application of wheels as a means of "varying and transmitting motion, but between this knowledge

"and a completed wheel, lies a long train of intricate processes, such "as pattern-making, moulding, casting, boring and fitting. Farther "on comes other conditions connected with the operation of wheels, "such as adaptation, wear, noise, accidental strains, with many "other things equally as important as involute and epicycloidal "curves or other geometrical problems relating to such gearing."

Improvement in machines, or adaptation it may be called, is arrived at by an evolution, a long, tedious, tentative procedure, even in what seems to be simple and plain.

The development of velocipedes is an example. A century of experiment, and a quarter of a century of persistent effort by hundreds, or even thousands of people among the most skilled, has been necessary to produce the present type of these vehicles with two wheels, equal in size and a multiplied motion from the treadle shaft to the wheel axis.

It is a matter of amazement to look back to the velocipede of Masurier, of 1779, and then follow down through the hundreds of modifications to the present type. It is not complimentary to human ingenuity, and is owing more than anything else to a want of analytical methods of investigation — a searching into causes and reasons in a logical way, a way of proceeding that the object of the present treatise is to promote.

The plan will be to attempt first a narrow classification into divisions or branches, then to amplify these divisions and further divide into types, going on progressively to particular machines and processes. This seems necessary, because to segregate a machine or a type of machines would obscure their relations and hinder a general conception of the subject.

CHAPTER I.

THE NATURE AND OBJECTS OF MACHINERY.

The functions of machinery are to generate, transmit and apply power, also in some cases for guidance, as in the pentagraph, or for measuring, as in computing and gauging machines, but the main functions first named embrace all that need be included.

To classify machines there are: (1) Generating machines, to utilize natural forces, including motive engines of all kinds, operating by the gravity, pressure and impulse of fluids. (2) Machinery

of transmission, for conveying power. (3) Machines of application, including all kinds of implements and work machinery. (4) Machinery of transportation, for conveyance by land and water.

These classes of machines will now be briefly reviewed, or as we may say, their definition extended. Afterwards they will be farther divided and classified, each being treated at more length.

MOTIVE MACHINES.

All motive engines operated by elastic fluids, steam, gas and air, derive their force from expansion; and as expansion is caused by heat, such engines are commonly called heat engines.

As heat is the primal source of energy, other motive machinery, water and wind wheels, are also heat engines in the sense that heat and energy are convertible, but the heat is not directly applied.

In the case of water power, the water has been expanded, converted to vapor, rises because lighter in that form than air, is precipitated as rain, and in its descent toward the ocean affords water power by its gravity.

Wind currents are also a phenomenon of expansion, caused by heat or variations of temperature, causing the air to rise in one place and descend in another, the horizontal or compensating flow causing winds of varying force.

Thus it may be seen that motive power or energy is a product of heat, directly or indirectly, and always manifested through the phenomena of expansion. Also that in the case of fuels, coal, wood, oil, copper, zinc, and so on, that the conversion to energy is through the agency of combustion or oxidation, which is in effect the same thing.

Following back further in the train of causes, it is claimed that physical energy is traceable to the heat of the sun, from which all forms of fuel are derived, mineral, animal and vegetable.

MACHINERY OF TRANSMISSION.

Machinery of transmission, or for conveying power, may be direct or mechanical, as in the case of shafts, gear wheels, bands, ropes, links, motion rods, and the like. The same class may include machines and apparatus to set in motion or impel fluids, such as water, steam or air, or may operate by means of electrical currents, now coming rapidly into use.

The choice between these different systems of conveying power, is not one of efficiency alone, otherwise one method would be employed generally. It is also a problem of adaptation to various purposes, as will be explained in future.

The main losses of transmission with mechanical apparatus, are by the friction of bearings and of the atmosphere, also to some extent by flexure of bands and ropes. By means of fluids, there are losses by friction, and of heat or volume, to which must be added the friction and other losses in the initial and receiving apparatus.

MACHINERY OF APPLICATION.

Machines of application are directed to certain processes, such as cutting, abrading, crushing, pressing, mascerating, forcing, lifting, lowering and manipulating; the latter to include textile machinery for weaving, spinning, knitting and sewing, and the like. There are also other classes distinct enough to be named, but the cutting classes of machines are by far the most numerous. They act on the principle of a cleaving wedge, or by edges, and include all kinds of machines for shaping forms in metal, wood and other substances not of a plastic nature or extremely hard. Even abrasive or grinding machines belong in this class if we consider the manner of their action and the form of the particles removed in these processes.

Machinery of application, like that of transmission, constitutes a kind of link between motive power and material to be acted upon, or the final object to be accomplished. The name is not wholly relevant, but is the best that can be thought of. In some languages the name given to machines of this class corresponds to the term "receptor."

MACHINERY OF TRANSPORTATION.

In this division or class is included the mechanism of propulsion or impulsion on land and water, and to a limited extent in the air. It is extensive, but is limited to a few types that have their counterparts in other uses, so their classification has more reference to purpose than to their nature.

In their development, however, they have been a distinct class. The marine engine, for example, now making its way from water to land, has always, or at least for a long time, as a class stood first in economy and endurance. The immediate cause of marine types of steam engines being adopted on land is the analogy between driving

propellers and dynamos. Both require a constant torque under normal conditions, and both require a rotative speed as great as the limits of construction and endurance will permit.

Locomotive engines were antecedent to modern high-speed stationary engines, and now stand far ahead in endurance and rate of rotation. Exposed to grit and dust, supported on yielding frames, rushing through the air, and performing irregular work, they are in respect to maintenance the most remarkable of all motive machines. The conditions of use preclude economy of fuel and heat, and we have the anomaly of both the highest and lowest result in motive engines for transportation purposes, marine engines and locomotives.

With this much in the way of classification, and to enable a more intelligent division of the subject in future, particular motive machines will now be considered.

CHAPTER II.

PRESSURE OR PISTON STEAM ENGINES.

Keeping in mind what was said of expansion, and that it is through this action that motive power is derived, we will now proceed to examine the reasons that have caused the wide and almost universal use of steam engines wherever fuel is available.

The operation of all heat engines consists in confining a volume of some fluid or substance, and adding heat to cause expansion. There are some fluids that expand in greater degree, and would give out more power than water when converted to steam, but they are either expensive, corrosive or have other qualities that unfit them for use. Among such fluids we need only mention two, ammonia and carbonic acid gas. These are not in use, though they have been many times tried. Water is found everywhere, is almost without price, is practically non-corrosive in the form of steam, and has a peculiar property of lubricating metallic surfaces, which alone is a sufficient cause for its preference.

The power or energy derived from any fluid by expansion is as its relative volumes before and after expansion, or before and after heat is added. For example, the difference between the volume of water and steam. A cubic foot of water converted to steam at a

pressure of 10 pounds per inch expands to more than 2,000 cubic feet of steam. At 50 pounds pressure it has 500 times the volume, and at 100 pounds pressure 270 times the volume, so that if the working pressure is 50 pounds per inch the power required to force a cubic foot of water into a boiler represents theoretically only one five hundredth part of the energy given off by the steam in escaping from the boiler, This energy is utilized by the engine. The amount of heat consumed in producing this expansion, its losses, distribution and final effect constitutes what is called thermo-dynamics, and is not a branch to be treated here farther than it effects the nature, form and operation of apparatus.

A common steam engine and its supply pump to force water into the boiler are therefore the two agents or machines forming the two ends, so to speak, of the cycle of a common steam engine. This relation of a supply pump, or corresponding apparatus, for introducing the expanding element against its final pressure is a condition and fact that should be kept in mind.

The term "feed pump," commonly employed, indicates a function like a supply of oil or fuel. Supply pump is a better name. It sends into a boiler the same element in liquid form that passes out through the engine as a vapor. The furnace and boiler are the agents of expansion, and the engine an agent for utilizing the force of this expansion.

When an element is expanded instantly, as by combustion in a gas engine, there is no stored volume as there is of steam in a boiler, so there is no resistance to the induction of the original elements, gas and air, and these flow in without a supply pump, so the latter is necessary only when there is a stored volume of the working element, as in the case of engines operating from a boiler or receiver.

Keeping in view the reasons for the wide use of steam engines, the plentifulness and cheapness of water, its non-corrosive and lubricating properties, and simple means of its expansion into steam, we will briefly refer to the losses, which are from 50 to 80 per cent., according to the perfection of the apparatus employed. Such losses are measurable by heat, the primal source of energy, water being, as before explained, only a medium of its conversion into work.

Steam under pressure has to be confined in a storing vessel called a boiler or generator, which latter is a much better term, and the heat taken up by or imparted to the water must pass from the

fire through the plates of the boiler by convection. Only a portion of the heat passes through the walls of the boiler in this manner, the rest escaping in various ways; by radiation, in the gases of combustion and in heating the air entering the furnace. The heat taken up by the water is also lost to a considerable extent in the exhausted steam and otherwise after it leaves the boiler, but all such losses would apply equally to any other fluid expanded by heat for producing power, and the objections do not therefore apply especially to water as a medium.

In attempting to generalize the conditions under which common steam engines operate we will be led far afield, and into mechanism and methods of which not very much is known at this time, but which is fast approaching the impulse class of motive engines for water, steam and air.

WHY PISTON ENGINES ARE THE COMMON TYPE.

The energy of steam escaping from a boiler suggests a continuous movement of the surfaces against which the force is applied, and as continuous movement must be rotary, a rational engine or "receptor" would be one having rotary movement, but this is not a common or even an exceptional form of steam engines, although there has been continuous effort for a century past to produce engines of this kind.

Another inference in respect to steam engines is that in applying any fluid to produce motive power the agent or engine should move at about one half the velocity or efflux of the fluid, but in the case of common steam engines there is not even an approach to this, the velocity of steam being at average pressures about 50,000 feet per minute, while the most rapid-moving engines do not attain more than a fiftieth part of this, or one twenty-fifth of the operating velocity.

The reasons for this absence of rotative or continuous movement, and the limitation of velocity, constitute one of the most interesting problems connected with steam power. Both these impediments or limitations in common steam engines are now likely to be removed, as will be explained in a future place, the present purpose is to seek out the conditions that have caused practice as it now exists. These reasons will lead into some constructive or working conditions that are far from being commonly understood, and to which especial attention is called.

Steam is commonly applied on reciprocating pistons, the motion of which is converted to rotation by means of cranks, the irregularity of the cranks being compensated by fly wheels. These elements, which in a sense seem superfluous, form an expensive portion of the parts composing a common steam engine, and were not introduced by chance, but have come down to us by an evolution of experiment by the best mechanics in all countries, and are the result of more than a century of experience.

Seeking now for causes that have determined modern practice, we find, first, that the movement of a surface impelled by steam must in the nature of things involve steam-tight moving joints. A steam piston 12 inches in diameter has a surface movement of more than six feet of area for each stroke of 24 inches, and if moving at 600 feet per minute, which is not excessive, the surface movement becomes 1,884 feet of area to be passed over in the same time. Now if we stop and consider this fact in the abstract, the inference will be that such a thing is impossible, and that such surfaces could not be maintained free from rapid abrasion and wear, let alone being maintained tight against the passage of a subtle fluid like steam.

Here then we have a most important fact in respect to a pressure engine, and may detect in it a limitation of velocity, also find evidence of the essential property of lubrication possessed by steam, but not the main reason why the movement is reciprocating instead of rotary.

This will carry us into another phase of working conditions in moving surfaces or joints in machinery, not in respect to steam pistons alone, but all moving surfaces or bearings.

In the construction and operation of machines there are certain rules or laws that must be observed, and if violated the result is failure. One of these laws, and one not very well understood, is that compensation for wear in a bearing of any kind must be in proportion to the velocity of its surfaces, in other words, the compensation or adjustment must be in proportion to the wear, and this is in proportion to velocity, pressure being the same.

All parallel bearings move with uniform velocity over their whole surface, so does a piston moving in a parallel cylinder. In both cases there is endurance, because adjustment or compensation for wear is transverse to the line of movement, and is also uniform in both these cases.

In rotary engines operating by pressure the same rule in respect to wear and compensation applies to the moving surfaces, but these

cannot be made to conform to the rule or law of uniform velocity and compensation for wear. The joints or moving surfaces have to be in part radial, or in the plane of rotation, and the velocity taken at any point is in proportion to the radius. Wear, as said, being in proportion to velocity, cannot be taken up or compensated in such bearings. Steam blows through, the machines wear out and are discarded.

No radial joint can be maintained steam tight. Wear may be little, but it begins at once and continues. Compensation is impossible, because it cannot be made in proportion to wear. The result is, as before said, leaks and early destruction of all rotary pressure engines that must in the nature of things have radial moving joints.

This seems a small matter to determine the fate of a class of machinery, but it has done so in the past, and will continue to do so in the future. It is true there are other impediments to the successful operation of such engines, such as the centrifugal force of moving parts not balanced across the axis, and the difficulty of varying expansion, but destructive wear is the insuperable difficulty in their way, and what has forced the adoption of reciprocating pistons, cranks, connecting rods and flywheels. This matter of wear in radial joints will be further treated upon under the head of the Schiele form of bearings.

THE ARRANGEMENT OF PISTON STEAM ENGINES.

The arrangement of double-acting steam engines in the forms known as horizontal, vertical, inverted and beam engines is an interesting study. The existence of all these modifications in common practice, and in all countries, shows it is not a matter of chance, and that substantial reasons exist for the different methods of arrangement.

Beam Engines.—These in theory and in fact represent the best arrangement for rotative speeds within their limit. Their special features are that the moving weights are in equilibrium, the pumps are worked direct from the beam, and the strains are more direct than in other engines. For these and other reasons they are more durable.

Their use on ferry boats in this country arises mainly from the fact that the machinery as a whole is set on its edge, so to speak, the main working parts above the deck, and the space occupied, a long narrow strip fore and aft that does not interfere with the deck

traffic and loads. It is true the engine space extends up through the cabin and above the roof, but this is not a great encumbrance. There is also the reason for ferry service that beam engines fitted with balance puppet valves as made at this day are easy to "handle" and keep off the centers, because in equilibrium.

For stationary purposes there are the objections of greater first cost, larger proportions because of slower speed, larger space occupied, but notwithstanding this, one of the finest plants for duty in cotton mills has just been constructed in England on the beam system, and the most complete pair of winding engines ever made on this Coast are at this time (1895) under construction at the Union Iron Works in San Francisco.

Horizontal Engines.—These, by far the most common form, have certain advantages. The working parts are in a convenient plane for construction, erection and attendance, and the position is "natural," if considered aside from the operating conditions.

There is no doubt this latter reason is responsible for the horizontal arrangement of a great many machines besides steam engines, that would be much better set in a vertical position, if friction, wear and endurance were considered.

The horizontal arrangement of steam engines admits of the most simple form of supporting frames, these being in effect only flanged girders with shallow cross section, easy to cast and plane, and otherwise prepare. It is also the method that best permits the mounting or connection of the parts and their alignment when bolted on, but most of all the various operations of fitting can be done by means of small machine tools.

There is also the advantage that the foundations are spread out over a large area, securing solidity of attachment.

There are also several objections to horizontal engines as they are commonly made. The strains are less direct, usually on one side of the axis of the main frame, and commonly a large part of the metal neutral, or not required to resist strain. The lateral or downward pressure caused by the weight of the reciprocating parts is also a serious objection, especially in the case of large engines, and has been one of the main reasons for change to the vertical and inverted types.

Vertical Engines.—This name is applied to engines having their cylinders set on the foundation or base plate, and the crank shaft placed above. It is an arrangement that finds its adaptation

in the circumstances of use, and may be said to have no other featůre to recommend it. One case wheie it lends itself to a special requirement, is in the case of overhead line-shafts to be driven by direct connection, and when large fly wheels have to be set above the floor or foundations, and in any case where the crank shaft must be set at some distance above the floor, as in the case of punching, shearing, and other like machines.

There is the objection that the disturbing elements that produce vibration, the crank connecting rod and crank shaft mountings, are at the weakest part of the framing, its unsupported end it may be called, and have to be resisted from the foundation or base very much shorter than the height. Engines are not arranged in this manner except for special purposes.

Inverted Engines.—This name is applied to engines with the cylinders set vertically over the cranks, now universally employed for driving screw propellers in vessels. This result has been from "natural selection." The machinery is disposed within an oblong space, fore and aft, which is most convenient; the disturbances of vibration are vertical, in the plane of a vessel's greatest stability; the decks form permanent stages for access and inspection, and with multiple cylinders the reciprocating weights are in equilibrium in so far as the shaft; the valves with their gearing perfectly so when balanced by steam pressure. There is also the advantage of room for superimposed or tandem cylinders when required, and above all an avoidance of side wear on the pistons and reciprocating parts by reason of their weight.

These, and other reasons, in favor of inverted or steeple engines one might think should all have been discovered at the beginning, but such things are not learned in that manner, at least have not been in the past. In the future, let us hope, there is more promise of adaptation without long tentative experiment.

Oscillating Engines.—This type is much more common in England than elsewhere. The term applies to a cylinder mounted on trunnions, oscillating on its axis to accommodate the lateral sweep of the crank, thus dispensing with a connecting rod, crosshead and girders, the piston rod being connected directly to the crank pin.

At first there was a persistent effort to perform steam distribution by means of, or through the trunnions, so as to dispense with valve gearing, thus reducing a piston steam engine to the most simple form it has ever attained, but these methods have failed in practice,

and oscillating engines are now commonly made with the usual slide or other valves like fixed engines.

The object sought in the oscillating type of engines, aside from simplicity and cheapness, was the saving of room, or their compactness, a feature conspicuous in English practice, where oscillating engines are in a great many cases set directly beneath the paddle shafts of steamers, and have given excellent service.

This method is not only applied to small boats, but to large steamers of the highest class plying in the English and Irish Channels.

The shortening of the stroke of engines, and various mechanical devices for diminishing the distance between the piston and crank has rendered the oscillating arrangement unnecessary.

The rapid movement of the cylinders on the inward stroke of the piston produces lateral strains on the piston rod, gland and pistons, that cause rapid wear and derangement, unless provided for by careful design, good material and the best of workmanship. In fact, but one firm in the world has attained complete success with oscillating engines, that of Penn & Son, in England.

SINGLE-ACTING STEAM ENGINES.

One of the most original and notable additions to the art of steam engineering during twenty-five years past has been single action, the steam applied on but one side of the piston, and holding the various joints continually in compression, or in one direction.

This invention, like all others, has come down through a period of evolution and improvement to which many have contributed, beginning with Hicks, of New York, and ending, as we may say, with Westinghouse in this country, and Willans in England, because no important addition or change has been made in single-acting engines for several years past. So intense has been the study devoted to this type by the able steam engineers' above named, and so complete their resources, that the subject is, no doubt, well exhausted, and no great change can be looked for in future.

The strange, complicated and ingenious modifications of single-acting pistons that came up during the period named forms quite a history, but they were all directed to the attainment of certain functions, namely: high velocity, still running, automatic compensation for wear, and lubrication by saturation.

The possibilities of engines of this type at first presented a great

problem, not among steam engine makers generally, most of whom condemned them because of their innovations, but among those who by impartial analysis of the operating conditions saw signs of a sweeping change, but there came about certain impediments that while they did not much interfere with the functions of the engines as operating machines, placed a limitation on their economy.

One of these things was the cooling effect of the open-trunk pistons, and consequent cylinder condensation; the other was an enforced amount of compression on the idle or inward stroke of the pistons that interfered with an economic steam distribution, and as these things appeared at a time when the economy of steam was a first and main subject of research and discussion all over the whole world, it did a good deal to discredit the single-acting system.

In respect to the matter of compression above mentioned, it is not very easy to explain in words alone. It relates to that main feature of all in single action, keeping the strains in one direction and the joints in compression.

On the inward or upward stroke, because nearly all these engines are made on the inverted plan, there was resistance on the crank pin during the time the piston was driven upward on its return or idle stroke until the crank had passed from the lower center through about 100 degrees of arc. Then the momentum of the heavy pistons and connections acted to carry these forward at a nearly uniform velocity, while the crank followed a path of gradually decreasing velocity, and to hold the piston back or down, and keep the joints in compression, a steam cushion had to be provided in the form of exhaust compression.

A volume of steam had to be entrapped in the cylinder to cushion the pistons, otherwise they would out run the cranks, and the engines would knock. This did not cause much loss, but, as remarked, it interfered to some extent with steam distribution by a single valve. These features have been in a measure remedied by tandem connected pistons, as in the Willans type of single-acting engines, now made in this country at Chicago, and involving complex problems that cannot be gone into here.

On the whole, however, the peculiar features of the engine, such as running continuously for months without adjustment or skilled attention, has given it a place that can be supplanted only by impulse engines. In fact the rank of the single-acting engine as a motor for driving electric generators has caused its extension and adoption in competition with double-action engines of the highest

class. In London, for example; throughout the United Kingdom, and in many cases in this country, single-acting engines have a first place for dynamo driving, and would have a still more extensive use had it not been that the makers of double-acting engines were by emulation and competition driven to a rapid improvement and adaptation of their own type to high speed by an increase of the area of bearing surfaces, and otherwise.

The element of weight, or what might be called "terminal" forces, was at first thought to form the main impediment and limitation of high speed, but recent experience proves that lubrication is the main thing, and this is possible inversely as the degree and constancy of pressure between surfaces, so there has been enormous increases of bearing areas and provision for copious lubrication, weight being almost ignored.

These remarks respecting single-acting engines, and a good many more that could be added, form an evidence of how slowly we proceed even in simple forms of machinery, and how little has been completely learned in centuries past of the intricacies of machine action. There are many men now living, and some of them yet at work, who can remember when surface velocity in bearings was regarded as a limitation of speed, and there was a constant attempt to reduce velocity by small diameters as the rotative rate was increased.

If, for example, a designer of twenty-five years ago had seen the connecting rod of one of the modern high-speed marine or dynamo engines he would have pronounced it impracticable, and that both its weight and bearing surfaces were inconsistent with high speed.

To show, however, that the increased area of bearing area is logical, it is well known that friction, the cause of heat and wear, increases directly with pressure, and inversely with surface, but only to a limited extent with velocity, also that the forces set up by momentum, controlled by crank motion, are trivial compared to the working strain on the bearings of engines, both as to intensity, and maintained contact that interferes with lubrication.

(To be Continued.)

PERPETUAL MOTION.

The term "perpetual motion" is irrelevant, and does not in its etymology convey the idea intended. It is employed to mean a machine that moves without a cause, or without the consumption of any natural element, consequently without cost. It is a mere concept, hence the name does not matter. No name at all would be better and more consistent. It is a kind of superstition, a belief in the supernatural, and a denial of dynamic laws, unsupported by the least evidence in facts, and, as a well-known steam engineer has defined it, "is a disease of the mind."

Just now the perpetual motion men are getting some vigorous thumps. Professor Henry Morton, of Stevens University, in the August number of *Cassier's Magazine* writes farther on "Engineering Fallacies," a most useful article that should be widely read. We had the honor to know Professor Morton intimately more than twenty-five years ago, when he was Secretary of the Franklin Institute, Philadelphia, and had always given him credit for being more of a worker than essayist, but his reply here to some criticism of his first article by the editor of the *Engineer*, London, must convince any one who reads the article first mentioned that his forensic powers are quite equal to his genius for analysis.

His account of a magnetic motor exhibited in Newark, New Jersey, in 1871, that had a success equal to the Keeley motor, is an example of the harm that can come from "mechanical superstition," or a want of faith in the immutability of the physical laws of nature. In this case it was claimed that 2½ horse power was developed for nine hours with a consumption of 3 ounces of zinc, instead of 22 pounds, which Professor Morton computed as the required amount for developing this energy from a battery.

He, with many others, visited the machine in Newark; editors of technical, secular and even religious journals endorsed the invention, and scoffed at unbelievers, but in the end it appeared that a hollow frame concealed a belt coming up from a sealed room below, rented by the inventor. He ran away in the end, and his machine was found in a junk pile, disclosing the mode of its operation.

We have scant respect for the education and reasoning powers of any one who in the face of the whole scientific world can at this day believe or admit any exceptions to what are called the dynamic laws and the conservation of energy when every operative motive engine,

whether impelled directly or indirectly by heat, is a practical proof of the truth of such laws. We are, however, near the end of such superstition. A few years more must so increase the number of people educated in the elementary laws of force and motion, also the relation between energy and heat, as to end the perpetual-motion idea.

The subject is complex, because combustion, or the phenomena of the conversion of fuels into work or energy, are dissimilar. For example, a pound of coal consumed in a fire is plain enough, but a pound of zinc consumed in a battery is not familiar, and a mystery to most people. Gunpowder or gas exploded by ignition is familiar as a source of energy, but the consumption of copper or hydrogen to give out energy is as obscure in a popular way as the Keeley motor, yet these are all fuel or heat-producing elements, measurable by known rules and laws.

An authority at hand says one ounce of coal converted to work or energy equals 695,000 foot pounds, that is, will raise that amount of weight one foot high in a minute. One ounce of gunpowder exerts 100,000 foot pounds; an ounce of zinc, 113,000 foot pounds; an ounce of copper, 69,000 foot pounds, and one ounce of hydrogen 2,925,000 foot pounds. Now all this is as clear and well known as the measurement of solids or the weighing of wheat, proved in endless ways continually, and the basis on which rests the practical application of the industrial sciences. Whenever anything moves, from a leaf to a ship, or a piano key to railway train, there is a corresponding consumption of primal energy, and of some element converted to heat and work, or a disappearance of heat, we may say, by transformation into work.

It is no longer common or necessary to trace out these phenomena by experiment. They are understood as laws of physics, and so accepted and applied all over the world by all those who have practically to deal with scientific, engineering and mechanical matters. No one questions the facts and the rules derived therefrom, but those ignorant of the fundamental or, as we might even say, the elementary laws of dynamics.

The perpetual motion inventor, or those who want to "gain power" or produce it without a corresponding consumption of some element by burning or oxidation, which is the same thing, are either ignorant, stupid or attempting to deceive people, and how they can command faith and followers at this day will constitute a matter of special wonder in the future when the history of schemes

like that of the Keeley motor are chronicled among the events closing the nineteenth century.

An eclipse may be computed ten or twenty years ahead of the event; the extent, places of observation and the duration to minutes laid down in accordance with the same laws that govern the flight of a projectile. No one questions this, and faith in science is here complete, but let the same person who made these computations assert that 772 pounds raised one foot high consumes or requires one degree of heat, that is, as much heat as will raise the temperature of a pound of water one degree, and there will be no faith in this. The problem will become more mystified and less understood if it is claimed that the equivalent of this heat can be computed in coal, wood, oil, zinc or copper. Still the latter propositions would be only elementary when compared with the calculations of an eclipse or other astronomical phenomenon.

It has long been a problem with those engaged in education how popular knowledge of power and its relations can be imparted so as to save the time, energy and wealth that are wasted each year in contrivances that controvert simple physical laws. Books have been written, notably among them the *Conservation and Corelation of Forces*, written about twenty-five years ago, that if read even by a half-educated person should at once dispel all illusions respecting the mystery of "power," as it is called.

This book consists of short simple essays by Mayer, Leibig, Carpenter, Faraday, and others, containing no computations of any kind. It has led many into a new light, and made their way plain, but a superstitious contingent remains, and must for a little longer, but, as before remarked, with the varied and extensive agencies now at work in our schools, colleges and engineering works and offices, the time cannot be far off when the perpetual-motion man will disappear, and with him let us hope the man who wants to "gain power by gearing," avoid "the loss of power in the use of cranks," aise water without compensating its gravity, and so on.

Gasoline Traction Engine.—The Otto Gas Engine Works, Philadelphia, Pa.

GASOLINE TRACTION ENGINE.

THE OTTO GAS ENGINE WORKS, PHILADELPHIA, PA.

On the page opposite is seen a plate illustrating a traction engine that inferentially at least must have a good many advantages over a steam one of like power. The weight is less, and the details are not so many as are necessary in a steam traction engine. The driving wheels are five feet diameter, sixteen inches face, and are driven, as shown in the drawing by elastic tension rods and springs between the wheels and the main gear wheel. The tank immediately under the engine will contain seventy-five gallons of gasoline, a corresponding amount of cooling water, enough for a day's work, is provided in the cylindrical tank forward. The whole scheme seems simple and complete.

Considering the circumstances under which traction engines are used, especially in farm work, it is remarkable that gasoline and oil engines have not been sooner and more widely employed for the motive power. The element of weight is necessary whatever power is used, but a steam boiler filled with water and a store of feed water and fuel exceeds the weight required for traction purposes when the wheels rest on the ground, besides the consumption of fuel and water by a steam engine causes great variation of the load, which is almost constant in the case of gas engines.

A traction engine is a very complicated kind of machine, expected to perform a wide range of duties that vary a great deal, in fact the design of such engines has remained for thirty to forty years past a most difficult problem for engineers and mechanics, so the slow adaptation and use of such engines is after all not strange.

We have recently passed over a road made with a traction engine, on the side of Clear Lake, California, in the mountains, forty miles from a railway, and there in that out-of-the-way place learned some things not known where machinery is more common and supposedly better understood. We were informed that the traction engine had torn up the chaparrel, raked off the ground, ploughed, scraped and ditched the highway, without the aid of horses, which is a very remarkable matter. We went to see the engine, and found it busy at work driving a saw mill, "having a rest" the owner of it said.

This engine has been up there in the mountains several years, three or more, busy all the time doing something in a place where of

all others one would think traction engines could not be used. The owner of the engine is a "genius," at least that is the term by which his abilities are described in the neighborhood.

Another strange case, and a parallel one, is the use of traction engines in the Sierra Nevada Mountains, in this State, and in Nevada, where hauling of all kinds is done with them. We remember some years ago of seeing quite a train of wagons crawling after one of these queer-looking machines, bringing freight into Truckee.

In the valley, where the country is level, and the amount of freight per mile ten times as much as exists in the mountains, there seems to have been no more if as much success in traction hauling, but on the whole, power traction here in California has not been a failure, and some advance in the engines should spread rapidly their use all over the country.

For agricultural purposes, or at least for ploughing, there is not much promise of success. The land is not suitable. A friend of Mr. John Fowler, the greatest maker of steam traction engines in the world, said he once heard Mr. Fowler say that in California the land had two conditions: "Mortar in winter, and cement in summer." This is to some extent true of adobe land, but of no other. Fuel and water are impediments on the wide plains, but on common roads there are no difficulties here in the way of traction engines that do not exist elsewhere in the same degree.

BYRON SPRINGS.

This remarkable place, if some hundreds instead of sixty miles away, would be better known to the people of this City, also, it may be said, if the waters were the same as in other places, that is, impregnated with iron, magnesia and sulphur, the springs would attract more attention. The fact is that here are thermal springs differing essentially from all others on this Coast, with peculiar virtues, and yet less known than a score of other places hundreds of miles away.

It is hard to imagine what kind of a subterranean laboratory can send up through the earth within the area of a few acres, springs at a temperature from 60 to 120 degrees, loaded with minerals of various kinds, from 400 to 18,000 grains per gallon. The latter seems incredible, three eighths of solid matter.

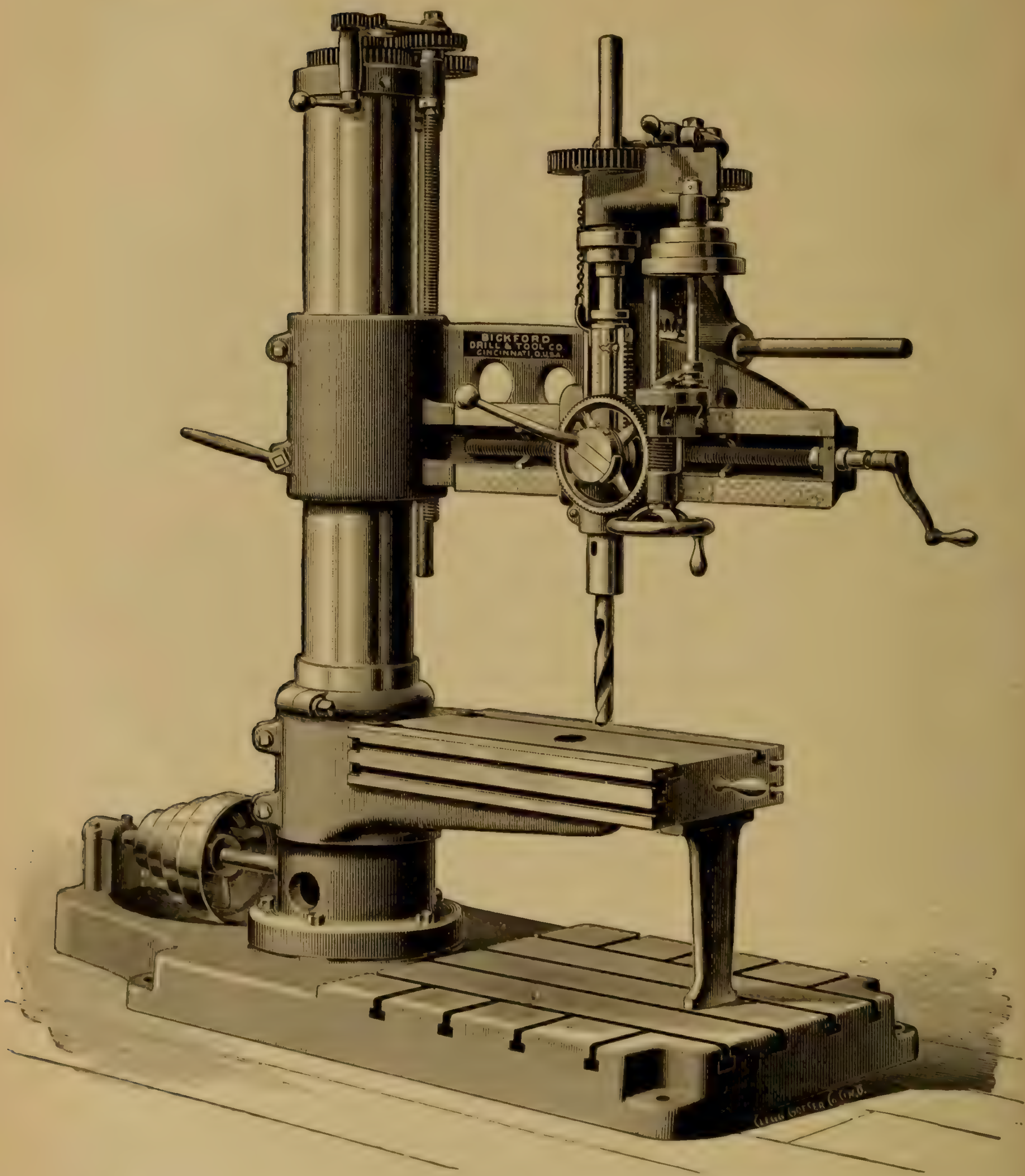
Most of the springs at Byron, both cold and hot, contain chloride of sodium, the principal or favorite baths having nearly 600 grains to the gallon, the only water of the kind on the Coast, not salt alone, however, but other ingredients with Latin names, all determined by careful analysis.

Byron Springs is a veritable chemical cauldron, lying at the eastern base of Mount Diablo, and seems an escape-way for the hydro-mineral secretions of the mountain. A short drive from the spring takes one up on the foothills, where huge towers of sandstone wrought into a thousand fantastical shapes, with round bowlders imbedded like plums in a pudding, remind one of the vast convulsions of nature that cast up this work within what geologists call "recent times," so that Byron, situated in the plain of the San Joaquin Valley, is not without an environment of the novel and picturesque.

The springs belong to Mr. L. R. Mead, the Secretary of the Risdon Iron Works and of the Manufacturers' Association of this City, who has spent there a great sum of money in developing the buildings, baths, gardens and the many things required for the comfort, care and pleasure of those who "seek the waters."

There are two particular features of these springs. One, that they are available in winter, because of the mild climate and the efficacy of the treatment in rheumatic affections, so common around the Bay of San Francisco. Covered passages lead from the hotel to the warm baths, and the buildings are warmed throughout by steam-heating apparatus, an essential provision in the treatment of rheumatic patients.

The physical circumstances of the place should form the subject of scientific research. There are not less than thirty springs in all, some of them flowing thousands of gallons daily, the most copious ones at a surface temperature of 120 degrees, which would lead to the inference that the surrounding earth was at the same or a higher temperature, but contiguous to such springs, and in some cases not thirty feet away, there are cold springs, all rising, so far as can be seen, vertically from the earth. It is a geological and chemical problem of the greatest interest. The chemical reactions that produce the heat and saturation are evidently far back under the mountain or the volcanic foothills, and why the water should make its way to a focal point at Byron and then come up in an alluvial district forms, as said, a fertile field for investigation, if that be possible.



RECENTLY DESIGNED RADIAL DRILLING MACHINES.

THE BICKFORD DRILL AND TOOL CO., CLEVELAND, OHIO.

Techno, in his discursive treatment of various subjects now and then has touched upon matters in a way that brought about changes of one kind or another. A dissertation on Swedish methods of planing wood by machines, about three years ago, with discussions that

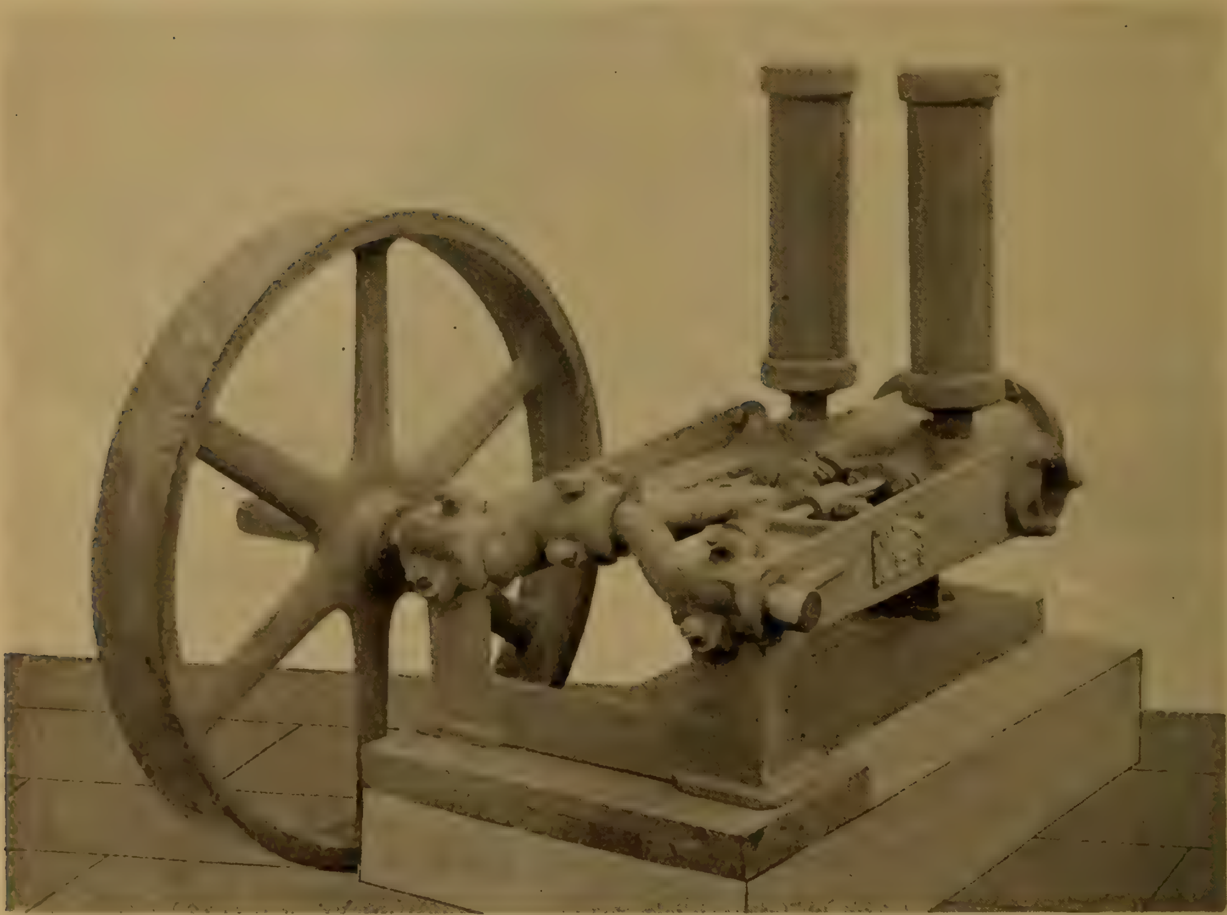
followed his views, called attention to the "wrong end foremost" method, and now at least one half the makers of planing machines in this country are making planing and matching machines that work the face downward, and plane that first, as a person would plane a piece by hand.

In our July number he discoursed on drilling machines and the method in which they are commonly back geared. This brought out from the Bickford Drill and Tool Co., at Cincinnati, a defense of their own practice, as illustrated in the machine shown opposite, that is geared directly on the spindle, and is a great improvement. We do not wish to intimate that these machines have been designed since Techno's criticism, because they have been made for four months past, and the company are preparing similar designs for other machines of their make.

For those who have not read the articles in "INDUSTRY," for July, we will explain that nearly all the makers of drilling machines do not place the back gearing on the spindles, but on some second shaft or second mover, so the strains in boring or slow running have to be transmitted through one or more, sometimes three, pairs of bevel wheels and several shafts, which taken together makes up a very complete spring. There is no steadiness, good work or comfort in a drilling machine thus arranged, and not much endurance, because the running parts soon wear out and break down.

This is the case with all machine tools similarly arranged. They should have their gearing on the main spindles, as in the case of lathes, which no one would think of constructing in any other manner. Large lathes are usually driven on the face plates to avoid the strains that would otherwise pass through the main spindle.

The machine shown in the drawing seems to be very convenient and adaptable, with ample proportions and adjustments for every kind of work. Messrs. H. P. Gregory & Co., of this City, are the agents here for the makers.



TWIN BARREL CONTINUOUS-FLOW PUMP.

C. H. EVANS & CO., SAN FRANCISCO.

Valveless double-barrel pumps have sometimes been made in this country, but not as a regular manufacture, although they are extensively used in some parts of Europe. There are two barrels side by side, with a bucket piston in each moving coincidently, which is the same thing as one straight barrel containing two pistons moving one after the other, the effect being to produce under ordinary conditions a continuous flow of the water, and of course a greatly increased capacity for a pump of a given bore.

There is also the peculiarity in these pumps that no valves are required, except those in the bucket pistons, and as these can be drawn out in a few minutes, repaired at a bench, and replaced, such pumps have a great claim for simplicity, as well as the advantage ot continuous flow when the pipes admit of that.

This subject, as our readers are aware, has been copiously discussed in "INDUSTRY" for years past, and we were astonished to

find such pumps working at the Mechanics' Pavilion on a recent visit there, made by Messrs. Evans & Co., of this City, and illustrated in the plate at the head of this article. What the working result has been we do not know, but if the conditions permit of a continuous flow there are certainly gains that should repay the makers for venturing into this new class of commercial pumps. They are made from 3 to 7 inches bore, to raise from 4,000 to 24,000 gallons an hour.

THE CONTROL OF ELECTRIC MOTORS.

In a recent conversation with a prominent maker of elevators in this City we gathered some information that is perhaps worthy of a note here.

"Driving elevators with electric motors," said he, "must be divested of all these throttling safeguards, such as resistance coils and crawling rheostat levers. The work must be gone at the same as it is with a column of water, by impulse, or else there can be no attainment of the functions we now have with hydraulic and steam apparatus. I have," said he, "two seconds to move one story, start and stop, and to do this I must have an armature 10 inches in diameter, set in revolution up to 800 revolutions per minute, sustaining a pull on its perimeter of 450 pounds, and do its hoisting and stop within the time named. This is the distinction between hydraulics and electricity as a motive power, and is the requirement of present practice.

"The armature must have all the inherent strength of a solid cylinder, and capable of electrical resistance up to the point I have named. It does not admit of tender care, and gradual starting. Nothing of the kind, it must stand the same treatment that a hydraulic or steam piston or other prime mover receives for this severe duty. This is imperative, and a condition of rapid stopping and starting. It is inherent as a principle, and no electric apparatus can handle and control a cage or load in any other manner at the speed and under the conditions that are now demanded."

These statements, which were new in so far as the relations between a prime mover and the motions of an electric cage, we soon identified with some remarks in our July issue on "Braking Electric Street Cars." It is the same thing in effect, and we have the pleasure to note that Editor Miller, of the *American Machinist*

comes out in a late article in a more vigorous manner than we dared, and shows that want of control over the armatures is the secret of weak brake power and consequent smashing of people with electrically driven cars.

This is, however, an easier problem than in the case of elevators and vertical travel, because with the latter starting must be as sudden as stopping, while in car accidents there is only stopping to deal with. There is also continual stopping and starting with an elevator, precise to an inch, with a time limit that there is nothing in street service to compare with. These things indicate the requirements of electric motors for intermittent service, and if the mechanical functions cannot be produced electrically they must be provided for by mechanical engineers, who can no doubt "find a way out."

In the case of the most severe service, that of elevators, our friend before quoted assumes that electric control is possible within the limits he names, and if so there is only a problem of endurance, also accomplished as he says, so the street-car problem should not wait long for solution. A yielding frictional connection between the armature shaft and axle like that of Walker's differential traction drums would answer, so would various other expedients. The main thing wanting is stringent and enforced ordinances defining the distance in which an electrically propelled car shall be stopped on a level way, and at a certain speed. Electric motors must either have a limitation in various uses, or else be capable of receiving the impelling force the same as water, steam or air are discharged against pistons.

We must admit that this function or relation between a prime mover and its resistances or duties is to us a new problem, and one that in so far as forces admits of ready analysis and demonstration. It is not limited to elevators and street cars, but is most important in these. The weight required in an armature is a formidable impediment. The *vis viva* of parts in high motion must be absorbed and dissipated instantly, which is, however, not so difficult a problem as overcoming the inertia in starting instantly.

KINETIC STABILITY.

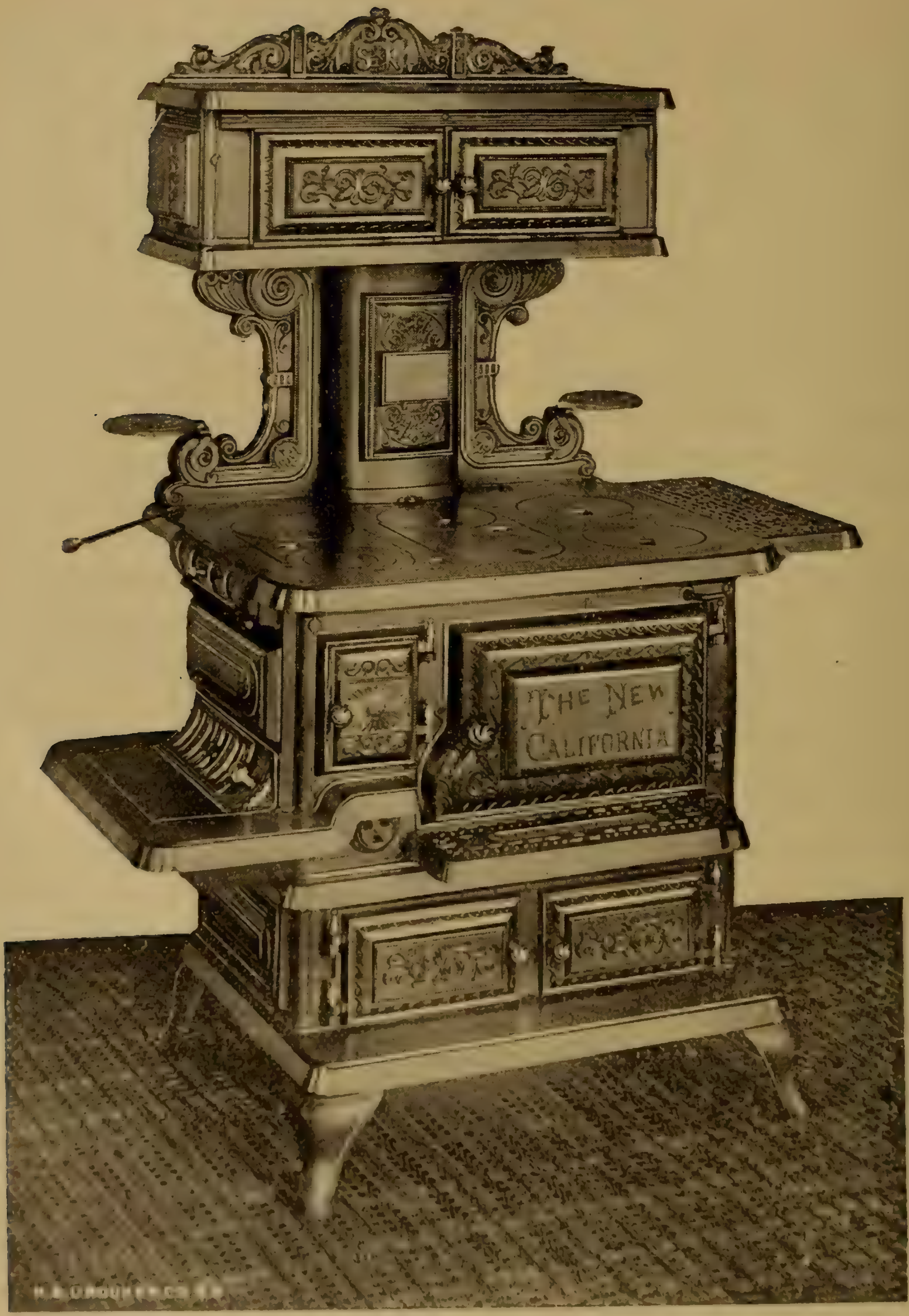
Robert Stevenson, C. E., of this City, a graduate of the University of Glasgow, and a pupil under Sir William Thomson, has during some years past contributed to scientific literature some very interesting and, we might say startling papers on "Kinetic Stability," meaning thereby the tendency of a body in rapid motion to continue in one line or course, and to return to the same if deflected.

This far the seeming problem involved is simple, and, as we have pointed out in some previous articles in "INDUSTRY" on this subject, is illustrated in many familiar ways, by the spinning of a top, the upright position of bicycles, a gyrostat, the straight flight of projectiles, and in other ways, but Mr. Stevenson carries operations of this kinetic law into a physical principle of nature, satisfying and substituting the phenomenon called gravitation, or the attraction of matter.

Mr. Stevenson has contributed weekly, for some time past, a series of articles on "Kinetic Stability" to the *Call*, published in this City, placing the subject in a popular form before the public; also has invited the University of California to prepare and conduct some experiments for which they have suitable apparatus, to determine whether the attraction of gravitation will affect the flight of a projectile in vaccuo when moving above a certain velocity. This experiment could be made in a long pipe from which the air is exhausted, and as such pipes are continually being made and laid for water, such an experiment would be easy to make if the pipes were level and would withstand the air pressure without collapsing.

Confirmatory of Mr. Stevenson's propositions we are informed that bullets fired from the Kraag-Jorgenson rifles at some late experiments did not fall in the first 1,800 feet, nearly a second of time, and if so it will be hard to explain this phenomenon on the theory of gravitation.

If circular movement is subject to the same laws as rectilinear movement, as the gyrostat seems to prove, it will be easy to try an experiment with apparatus of this kind, that is, with a wheel driven at a speed corresponding to the conditions required for sustension by kinetic stability. Considering the inexpensive nature of experiments of this kind, we hope that the subject will receive some attention in a practical way now that high velocities are so easily attainable by the efflux of steam or air without gearing to increase motion.



CALIFORNIA RANGES AND STOVES.

STEIGER & KERR, SAN FRANCISCO.

Among the various exhibits of domestic industry at the Mechanics' Institute Exhibition, now going on in this City, few have attracted as much attention as California-made stoves and

ranges from the Occidental Foundry, and certainly no exhibit deserves more credit.

Messrs. Steiger & Kerr bring to their aid a long experience in the foundry business, and in certain branches stood at the head among the works on this Coast. In the stove-making department there will no doubt be applied the same skill and energy. The foundry is a spacious one, with a large area of buildings suitable for stove fitting separate from the moulding and melting department, and the equipment of overhead travelling cranes electrically driven with other improvements have been before described in "INDUSTRY."

We have examined the stoves made by the firm, and found the fits, finish and weights are fully up to the high standard in this country, where the art has attained a reputation far in advance of the European trade. The practical conduct of skilled industry is a good deal the same in various branches, and from the careful records and ever ready data at the Occidental Foundry in respect to general business there is a right to infer that the owners know just what they are undertaking in stove making. Now it remains to be seen if the stoves and ranges will be purchased here on the same terms as imported ones, and whether the industry will be promoted or opposed by dealers and users of this class of manufacture.

Stove pattern making, moulding and finishing calls into play mainly a higher class of labor, and also has the quality of permanence, so much to be desired in Pacific Coast industries. The stock of stoves is commonly not large, and the consumption and prices tolerably uniform from year to year.

We neglected to mentioned that the stoves at the Pavilion on exhibition were taken from the common stock at the warerooms of the firm, and are fairly representative of the work made. This is much better than an exhibit of plated work made for display, and is fair to all concerned. The engraving shown is taken from a range with closets in the base and above, and an oven 18 $\times$ 18 inches, and is one out of a large number prepared from photographs of the stoves and ranges, of which a full list is made.

THE FACULTY OF INVENTION.

Mr. W. H. Smyth, of this City, a well-known engineer and mechanic, has in the *Engineering Magazine*, for August, presented an essay on the subject above that comes timely, or at least needfully, to combat the commonly conceived idea that invention is a special attribute or faculty of the mind. Mr. Smyth's view that invention is but the ordinary exercise of mental skill and power of selection is incontrovertible, and is in one sense an affirmation of the principles laid down in Holland when the patent laws were abolished there about forty years ago.

The Dutch went still farther, claiming there could be no natural individual right to an invention, because it was but the exercise of skill and common knowledge, and that one person as well as another could make the same invention when a want of it was discovered, and that patents related to opportunity. This extreme view has since been modified, and a new patent law instituted in the Netherlands, but the significance of the matter rests in the fact that at the time, opposition to patents grew out of the assumption combatted by Mr. Smyth, that invention was a peculiar faculty aside from the exercise of skill and knowledge.

If, however, the author had extended his inquiry to natural right and monopoly he would have found the cause that has led to the views he combats. We do not say that a personal quality is essential to a personal right, believing otherwise, in what we call invention, but it is easy to find here the foundation of the myth called the "inventive faculty." Patents for a century past have been slowly changing from an "act of grace" to one of "right," and were it not for the difficulty of legislators understanding the subject we would long ago have had laws that were clear and equitable.

The inventive faculty, which Mr. Smyth calls a "myth," has long been treated by the courts as a "fact." For example, in *Pearce vs. Mulford*, 102, U. S., 112, 26 L., ed. 93, it is declared that "all improvement is not invention, and entitled to protection as such. Thus to entitle it, *it must be the product of some exercise of the inventive faculties.*" Here is distinct assertion of a peculiar faculty of invention, placed in contrast with "improvement," declared in the statute as the essence of a patent.

The late Mr. Edward S. Renwick, an engineer and eminent

expert in patent cases, says, in commenting on the above: "What these faculties are, or how they are to be distinguished from the constructive faculty of the mind, is a matter left by the court in profound obscurity."

In *Robinson on Patents*, quoted by Mr. Smyth, page 114, it is said "an invention is an unchangeable fact to which the law must conform," which is inconsistent with a quotation from the same authority by Mr. Smyth. On the whole we think he will fall into very good company, and find that logical analysis of any kind will bear out the propositions advanced in the article under discussion.

Mr. Smyth knows well, indeed no one knows better, that legitimate invention is bringing to bear in a deliberate and systematic way acquired knowledge and skill to accomplish some end in a new and better way. As he says, there is no original thought in the case as is laid down by jurists, and the wonder is that any other conclusion was ever reached by skilled men, perhaps never was. The legal proposition need not be regarded, because one who never had to do with the processes of invention or "selection," as Mr. Smyth has happily termed it, can not conceive of the powers brought into play by an inventor. There is undoubtedly a facility of inventing or improving possessed in widely varying degrees by those who apply for patents, but this distinction is one of skill, logic and method, not one of faculty.

Now that the subject has been opened we can hope for discussion that may render useful assistance in certain reforms in our patent laws, very much needed at this time.

Since the above was written the *Engineer*, London, has reprinted Mr. Smyth's essay, and has weakly commented upon it, much the same as that heavy authority took to task Prof. Henry Morton on the subject of "Perpetual Motion Contrivances," and we may add not in keeping with the ability that one should expect from the *Engineer*. It is not worth while to follow out its conclusions.

NEW MODE OF PRESERVING FRUIT.

U. S. Consul H. P. du Bellet, at Rheims, in France, has sent to the State Department, at Washington, a communication respecting a new method of preserving green fruit that will have much interest on this Coast. The discovery was made by Mr. A. Petit, chief of the Laboratory of Horticultural Research at the National School of Versailles, certainly a proper person to deal with the subject. The following extracts from Consul du Bellet's communication will show the nature of the process:

"Impressed with the powerful action of alcoholic vapors on the mold, which generally appears on the surface of fruits in a damp atmosphere, Mr. Petit noticed that pears and apples kept for several months in a surrounding saturated with vapors of water and alcohol even were they at the beginning in a state of decay, showed no signs of mold, while fruits in every particular identically similar to the former, stored under the same conditions, but not exposed to the action of alcoholic vapors, were entirely covered with it.

"Taking advantage of this observation Mr. Petit applied the principle to the preservation of fruits in general, and most particularly to grapes, because more than others the latter are subject to mold. It was to be foreseen that grapes kept from the day they are cut off the vines in an atmosphere saturated with vapors of water and alcohol would by the retarding of the sweating period not only remain free from mold, but would even retain their natural aspect. Consequently should the temperature be constant and low the preservation could be maintained long and well.

"On the 31st of October, 1894 — that is very late in the season and a very unfavorable time — Mr. Petit placed with other fruits and a bottle filled with 100 cubic centimeters (61 cubic inches) of alcohol at 96 degrees, some bunches of grapes known as 'Chasselas de Fontainebleau,' fresh from the vine, in a brick recipient in the form of a parallelopiped, cemented inside, and closed as hermetically as possible by a common wooden door. In two similar recipients contiguous to the first, one of which was kept open and the other closed, but without alcohol, were stored similar fruits from the same trees and vines. The fruits were laid on wood shavings. The recipients were built in a very damp cellar, the temperature of which varied regularly from 10 degrees to 8 degrees C. (50 degrees to $46\frac{2}{5}$ degrees F.) during the whole time the experiment lasted.

"On November 20th the grapes placed in the recipient left open, and especially so those in the closed recipient without alcohol, were mostly rotten and covered with mold, and were immediately removed. In the recipient containing the bottle of alcohol the grapes were beautiful; on one bunch two grapes had turned brown, but were firm and free of mold; they did not taste at all sour.

"The hair hygrometer in the recipient registered 98 degrees. On December 7th the bunches of grapes in the recipient containing the alcohol had kept their fine aspect; on most of them, however, one or two grapes had turned brown, and were in the same condition as those above referred to. On December 24th, same results, on most of the bunches could be seen one or two grapes commencing to decay. At the end of nearly two months each bunch had lost but from two to four grapes each, and all were in a perfect state of preservation, the stalks being perfectly green, and the grapes firm, full and savory, and having all the qualities of fresh-cut grapes.

"At the conclusion of the experiment 28 cubic centimeters (17 cubic inches) of alcohol at 60 degrees remained in the bottle out of the 100 cubic centimeters (61 cubic inches) at 96 degrees, but, as Mr. Petit remarks, the door of his recipient had not been built with great care and did not close hermetically, hence a useless consumption of alcohol.

"This process offers many advantages. It is simple, easy of application and cheap, and if adopted by our fruit growers would allow them not only to hold their fine fruits until they can dispose of them at a fair price, but would also insure them handsome profits during the winter months."

Now and then among the many modifications of water-tube boilers, some one strikes a new idea, and in this number seems to be Mr. Haythorne, of Glasgow, who bends a series of tubes to an arc of about 80 degrees, attaches one end to a vertical member and the other to a horizontal pipe behind the grate bars. This disposes the tubes in the form of a bow, permitting free expansion, and also places them directly across the path of the fire. The tubes are fastened by means of screwed ferrules, having a thread on the pipe and also in the tube plate. The horizontal or bottom members, in which sediment will collect, are open at their outer ends, that is, have removable caps for cleaning, and the whole is evidently an advance in this much varied art. In a test by professional people the boilers evaporated from 10 to 11.6 pounds of water, burning from 10 to 50 pounds of coal per foot of grate surface.

THE MODERN GAS ENGINE.*

BY G. E. STEVENSON.

"The history of the modern gas engine commenced with the invention of the Otto motor in 1876, but the most rapid and extensive development has been subsequent to the expiration of the Otto patents. Prior to this the ingenuity of inventors was chiefly employed in devising methods of construction which, while not infringing those patents, would be of a practical and economical character, affording a prospect of successful competition with the Otto engine.

"As regards the latter, its makers had continued steadily to improve the details of the engine, and especially so by the abandonment, in 1888, of the slide valve. This part of the engine was always its weak point, for the slides could never be kept in order for long together, and it was found necessary to supply them in duplicate, in order that the engine might not be standing whilst they were re-faced. This difficulty was obviated by the substitution for the slides of lift valves, the surfaces of which, not being subject to the same wear, will keep tight for an indefinite period. They also possess the advantage of effecting a much more instantaneous admission than was possible under the old method. Although this improvement did much to encourage the use of the gas engine as a motor, yet, owing to the protection afforded by the patents covering the Otto principle, and the consequent fact that engines of this type could only be obtained from the licensed makers, the superiority of the Otto cycle was constantly called in question, and new types of engines, claiming advantages over it, were constantly brought before the public.

"Before proceeding to indicate the lines on which the modern gas engine has been developed, it may be useful to describe briefly the principal types which led up to it.

EARLY TYPES.

"Mr. Dugald Clerk, himself the inventor of an ingenious gas engine, classified all gas motors under three types: (*a*) engines ignited at constant volume, but without previous compression; (*b*) engines igniting at constant pressure, with previous compression; (*c*) engines igniting at constant volume, with previous compression.

*Paper read before the Incorporated Institution of Gas Engineers, London.

"To the first of these types belonged the Lenoir engine, the Hugon engine, the Bisschop engine, and the Otto and Langen engine. The last of these was a 'free-piston' engine, in which a vertical piston was driven upwards by the explosion, and, in descending under the pressure of the external atmosphere, engaged with and revolved the fly-wheel shaft. The second type was exemplified in the Drayton engine, which, although never assuming practical importance, was at one time made in an improved form by Messrs. Simon, of Nottingham. In this, the combustion of the gas and air, issuing from the orifice of a separate chamber in which it was previously compressed, was made to take place gradually, and thereby a constant pressure in the cylinder was maintained. To the third type belong all the more modern forms of gas engine, in which a constant volume of an explosive mixture, forming the charge, is first compressed and then exploded in the cylinder of the engine, causing an initial maximum pressure, which is afterwards reduced by expansion of the gases.

"This type of engine, previous to the expiration of the Otto patents, was represented by two distinct classes, viz., the Otto engine, in which the cycle of operations in the cylinder occupies four piston strokes, giving an impulse once only every alternate revolution, and those having for object the realization of a working stroke in each revolution.

"The Otto is based on what is known as the Beau de Rochas cycle, patented in France in 1862. Its sequences are well known, but for the sake of clearness it may be well to recapitulate them. A mixture of gas and air of definite volume is drawn into the back end of the cylinder by one forward stroke of the piston, at the end of this stroke the admission valves are closed, and on the return stroke the mixture is compressed at the end of the cylinder, where a certain clearance, or back chamber, is provided for the purpose. On the next outward stroke ignition takes place, and the pressure generated by the explosion gives the working impulse to the piston. The fourth stroke of the cycle, viz., the second return stroke, is devoted to expelling the waste products.

"Those makers of gas engines who were not entitled to use the Otto patents endeavored to solve the difficulty by compressing the charge in a separate chamber, instead of in the engine cylinder. By this means they were enabled to obtain an impulse at each outward stroke of the piston, inasmuch as the operations of drawing in and compressing the next charge were performed during the active

or explosive stroke and the next return stroke of the engine piston. This was the method adopted in Clerk's engine. In the 'Robson' engine, made by Messrs. Tangyes, Limited, the operations of charging and compressing were performed in the front end of the engine cylinder, which was closed like that of a steam engine. In the original 'Stockport' engine a second cylinder was used for this purpose, the front end of the trunk of the engine being formed into a second piston working in the charging cylinder. Another engine embodying the same idea was the Atkinson 'Differential' engine. From all these, results were obtained which made them by no means to be despised as competitors of the Otto; but, unfortunately, the makers in few instances could escape the charge of infringement of the Otto patents. Mention must also be made here of the Griffin six-cycle engine. This engine embodied the Otto cycle in the first four strokes, but the fifth and sixth were devoted to drawing in and expelling a charge of pure air, which completely displaced the burnt gases.

"With the expiration of the Otto patents, however, the *raison d'étre* of all engines on other than the Otto principle fell to the ground. The fact is that the Otto system is at once the simplest and most economical of application; all other types of engine which necessitate separate appliances for the preparation and compression of the charge being more complicated in construction and more costly to manufacture. At the present day they have all been abandoned, and their makers have adopted the Otto cycle. The recent development of the gas engine has been essentially on Otto lines, and is an approximation of all to one standard type.

"The first requisite in the successful development of the gas engine being economy in fuel consumption, it is natural that the attention of inventors should have been primarily directed towards the production of greater efficiency. In the earliest gas engines one or other of two defects invariably existed; either their fuel consumption was extravagant, or the power exerted was very small in proportion to their size. The former defect was owing to the fact that the differences of pressure and temperature at the beginning and end of the cycle were small, and consequently little useful effect was developed by the combustible. Non-compressing engines of the Lenoir type worked with low initial pressure and very incomplete expansion. A large amount of gas was subjected to combustion, but a very small percentage of the heat evolved was converted into mechanical work. The efficiency of the Lenoir engine was only 4

per cent. The Bisschop engine, and the Otto and Langen engine were more economical, because, although non-compressing, the time and space afforded for expansion were much greater. On the other hand, they exerted a very small power for their size and weight.

"The introduction of the principle of compression saved the gas engine from being relegated to that limbo towards which all hot-air engines have hitherto gravitated. It rendered possible the utilization of a much larger percentage of the energy developed by providing the means for extensive expansion of the products of combustion, at the same time that it concentrated the forces at work by producing a higher initial pressure and temperature than were previously possible. With the introduction of the Otto engine the consumption of gas was reduced from 25 to 35 cubic feet per indicated horse power per hour. From 1880 to 1890, by modifications in the proportions of gas and air, and other improvements, the consumption was reduced to about 25 cubic feet for the smaller and 20 cubic feet for the larger engines per effective horse power.

THE 'SCAVENGING' SYSTEM.

"It has however, been reserved for the past year's improvements to bring about a further marked reduction in the gas consumption by the adoption of what is known as the 'scavenging' principle. This principle is not new in itself, having been carried out, as has already been stated, in the Griffin six-cycle engine, which, however, involved the disadvantage of prolonging the cycle by two additional strokes, thus diminishing by one third the power of the engine. In the original Otto a portion of the waste gases always remained behind, and, becoming mixed with the succeeding charge, diluted the mixture and weakened the force of the explosion. A slow explosion is manifestly incompatible with a high initial pressure, and the value of the latter having been recognized, an improvement has recently been introduced by Messrs. Crosby Brothers, by which the spent products are swept out at the close of the cycle without recourse to two additional strokes of the piston.

"This is effected by opening the air-admission valve a quarter of a revolution before the discharge valve is closed. This latter opens at three fourths of the semicircle on the forward working stroke, and is not closed until one quarter of the semicircle on the next forward or suction stroke has been performed. It, therefore, remains open for three fourths of an entire revolution. The air-admission valve

opens before the piston has returned to the back end of the cylinder, at three fourths of the semicircle on the return discharge stroke. A long vertical discharge pipe is attached to the engine, and the rush of the spent gases up this pipe causes a vacuum by which air is sucked through the engine and up the pipe, sweeping all the spent products before it. The result of this is that when the discharge valve closes and the gas admission valve opens, the space behind the piston is filled with pure air, and a correctly proportioned mixture is formed, the explosion of which produces an impulse of full and uniform strength at each working stroke. This is the joint invention of Mr. Frank Crossley and Mr. James Atkinson, who is now associated with Messrs. Crossley Brothers.

"Besides this improvement, an increase in the amount of compression has also been effected. Formerly from 40 lb. to 60 lb. pressure per square inch was usually obtained in compressing the charge. This is now increased to 80 lb. or 90 lb. The effect of this, together with the purity of the charge, has been to raise the initial to about 300 lb. per square inch.

"The economy resulting from these improvements is remarkable. The gas consumption in the new engine is reduced to 16.48 cubic feet per effective horse power, as against 23.87 cubic feet in the older engines. The actual efficiency of the new engine is stated by Mr. Atkinson to be 28.26 per cent., as compared with 22 per cent. actual efficiency in those of the older type. It may here be stated that by actual efficiency is meant the ratio of the heat converted into work to the total heat developed by the combustion of the gas. When coal gas is used some 6 per cent. is required to be deducted to arrive at the net heat effect utilized from coal. The mechanical efficiency is the ratio of the effective or brake horse power to the indicated horse power. This, in the best engines, has been brought up to 86 per cent.— that is to say, 14 per cent. only of the power exerted is spent in working the engine itself."

(To be Continued.)

LITERATURE.

Those sending books for notice in this department are requested to mark in review copies the price at which the book is sold.

An Elementary Text Book on Steam Engines and Boilers.

BY PROF. I. H. KINEALY.

This work, by Prof. Kinealy, of the Washington University, St. Louis, Mo., brings to mind in a forcible manner the difference between the present time and the past in respect to technical text books.

Tredgold's Treatise on the Steam Engine was good for forty years at least, and we can well remember when no one thought of it ever being out of date. Later books of a less pretentious kind fought out an existence of twenty years, but the period in which a work on steam engines could remain relevant and comprehensive has shortened until a few years is the limit of life for any treatise dealing with constructive features or even with types of steam engines.

This then becomes a reason for new books and a revision of old ones, each new issue coming nearer in the wake of modern practice, but done in varying degrees of perspicuity and usefulness.

So also is there a like advance in the theoretical part called thermo-dynamics; not in principle or nature, but what is equally important, in methods and means of explanation.

The present work is a good illustration of this. It begins with elementary thermo-dynamics, treating the subject in a lucid and interesting manner up to such point as the student or reader can be trusted with the disturbances and wastes of an actual heat engine. We much doubt if the subject was ever before so adroitly handled in so short a space, and this is as much in commendation as we know how to say.

The introduction of specific illustrations to show types of engines and their parts, instead of diagrams, is a doubtful addition to the work. It answers the purpose, and answers it well, but gives to an otherwise high-class text book a tinge of the "trade treatise" of our time, and is inconsistent with the admirable text in conjunction.

The chapters on the admission of steam by valves and on valve and indicator diagrams are especially clear and methodical, if that term applies; so also the chapter on heat and combustion, a commendable one, corelating with the earlier chapters on thermal values and quantities. Boilers and chimneys (not "stacks") have short sections at the last, and some useful tables of reference from the end. The nomenclature is a delight, and a relief from a custom of technical "slang" that has crept into modern terminology in a wonderful and regretable degree.

The book is 6 × 9 inches, contains 236 pages, and is published by Messrs. Spon & Chamberlain, New York.

The Lixiviation of Silver Ores with Hyposulphite Solutions.

BY C. A. STETEFELDT.

We announced some time ago that Engineer Stetefeldt had in view a revision and new addition of his work on lixiviation. This has been done, and the volume is now before us, done in excellent form in the interest of the author, who himself publishes the work in this country, and has delegated the sale in Europe to Messrs. Craz and Gerlach, of Freiberg, Saxony, Germany.

In few cases is an author so intimately associated with an art forming the subject of his writing, or so well known in the field to which it pertains, hence this "auto-publication" is consistent, and no doubt expedient.

The following from the author's preface indicates best the scope of the present edition, the first one having been for some time exhausted:

"In this second edition of the Lixiviation of Silver Ores with Hyposulphite Solutions, some errors which occured in the first one have been corrected, irrelevant matter has been left out, and a great deal of new matter has been added. How materially this new edition has been changed becomes evident from the fact that nearly one hundred pages

of the text in the first edition have been cut out and replaced by new matter. I have not considered it necessary to reprint drawings of the details of a lixiviation plant, such as ore tanks, precipitating tanks, etc., because all this apparatus is so simple that it can be described just as well."

The author's work here is not, as already intimated, one of compilation or collection, but rests mainly on experience and what we may call personal demonstration. He has long been indentified with extraction processes, and on this Coast is an authority in all that pertains to this branch of metallurgy.

The Russell process, to which this work is especially directed, and a history of precedents in lixiviation forms the first section, or introduction, and will have greatest interest to those who cannot master or understand the technical nomenclature and formulæ that enter into the practical part of the book, and of which we confess to no knowledge that permits opinion.

We note a dedication to Prof. Bruno Kerl, of Berlin, the author's former teacher, and in that connection recall the author's heretical opposition to classical studies instead of physical sciences, that kept him in "hot water," as we may say, during a stormy studentship in Germany.

The unquestioned value of this contribution to metallurgical chemistry, coming as it does at the beginning of a renewed activity in our mining interests, must insure a wide sale of the work.

The book is 6 × 9 inches, contains over 200 pages, is well printed, substantially bound, and is sold for $5.00. Copies can be ordered from the author, Oakland, Cal.

Electricity in Homes and Workshops.

BY SYDNEY F. WALKER.

This work, sent by Messrs. Van Nostrand & Co., New York, can be disposed of in the statement that it has reached a third edition, and has had favorable notice in these columns before.

The technical features of the book thus proved commendable and useful are not however its only feature. The idiom and diction betoken scholarship and care, which is a good deal more than can be said for all books of the kind now appearing.

To a great many readers even new and useful information is passed over when smothered in language that is neither elegant, perspicuous nor grammatical. In this case we do not see how the author could say more or say it better within the limits laid down and set forth in the first preface:

"An attempt to explain in simple terms the ordinary every-day working of some of the forms of electrical apparatus that are in use by outsiders, and not under the constant supervision of trained electrical engineers, and also it is hoped that they will be of service to young electrical engineers who are just commencing to make their practical experience."

The glossary of terms, or the analysis of terms, it may be called, is the most complete that can be referred to in an adaptation to elementary study.

The present edition with revisionary matter makes up 350 pages, and is sold at $2.00.

Journal of the Associated Engineering Societies.

The issues for May and June of the present year have been received, containing eleven papers as follows: "The Industrial Problem of the Pacific Coast;" "The Relation of Railroad Transportation to Production in California;" "Notes on the Construction of the East River Gas Tunnel;" "The Abolition of Grade Crossings between Railroads and Highways;" "Abolition of Grade Crossings on the Providence Division of the Old Colony Railroad in Boston;" "The Chicago Sanitary District Canal;" "Should our Patent Laws be Abolished or Modified?" "Pressure and Impulse in Motive Engines;" "Engineering Education;" "Wooden Bridge Construction on the Boston and Maine Railroad;" "An Encased Standpipe with Special Provisions for Wind Pressure."

These publications have been from the beginning improved in value, and from the manner of their production, or manner of selection, should take a high place in useful technical literature.

There are in the Association eleven societies, situated in the principal cities of this country, who pool their transactions, as it may be called, and have them collated and edited by a secretary at Philadelphia, Pa. This cheapens the cost of production, insures careful work, and gives the papers, such as are selected, a very wide circulation.

The subscription to the journal is $3.00 a year; single numbers, 30 cents.

Proceedings of the Engineers' Club, Philadelphia.

NUMBER 53, JULY 1895.

The present volume of proceedings, from April to July, 1895, is characteristic of the work of the Club, and compares favorably with that of the foremost societies of the kind. It is organized on a principle that we have always believed to be the most efficient and useful, that of local and independent organization, and incidental connection with a national or international association.

An American society with a membership all over the Union is an unwieldy affair, or, as we may say, an impossible one in so far as attaining the ostensible functions of intercourse, mutual contribution and advantages. For example, what advantage can a member on this Coast derive from the library, meeting rooms or even meetings of the American Institute of Civil, Mechanical or Mining Engineers. There are the private transactions, which are obtainable by any one who will buy them. The Engineers' Club, at Philadelphia, the Technical Society of the Pacific Coast, and those comprising the Association of Engineering Societies, eleven in number, are all organized on a better plan, as appears from the attempt to split the National one into branches.

Passing from this digression to the present proceedings: There is a very interesting paper by Mr. J. R. Maxwell on "Railway Construction in the Andes," in which appears various facts of interest to our readers.

There is mention of Harry Meigs, as he is called here, and his railway schemes in Peru after that country discovered the art of borrowing money. Mr. Maxwell says that in 1872 Meigs had railway contracts to the amount of $100,000,000 for roads to be constructed in all kinds of inaccessible places, narrow and wide gauge. In one case, through a cañon 70 miles long, one tenth of which had never been penetrated by man. In one place there were five tunnels in less than a mile.

The author remarked that it cost more to make a mule track on this road than it does to build a common railway complete. In one case there was no water for a distance of 70 miles on or near a line that was built, and the hauling of water cost over $500,000. Afterwards there was laid a pipe line 84 miles long for a supply, the difference in level traversed by the pipe was 6,000 feet, which certainly afforded the required pressure.

Another line from Arequipa rises 14,000 feet in a distance of 118 miles, so high that the Chilian workmen could not cook their beans except in closed vessels under pressure. The most remarkable line of all, however, started at Callao, and climbed to a height of 15,666 feet, which is perhaps the most elevated line in the world. It was intended to reach the Amazon River, and is completed up to the highest point. There are on this line 57 tunnels in 24 miles. In constructing these mountain lines workmen from England could not stand the attenuated air and soon went away.

The Monthly Journal of the International Association of Machinists, Chicago.

D. DOUGLAS WILSON, Editor.

For a number of years this journal has come to hand, but being a class one, and representing a body not much given to coöperative action, we have watched it with some interest as an exponent or "coefficient" of the whole system of coöperative effort among mechanics. In five years the journal has doubled in size, and quadrupled in dignity, make-up and literary dress.

We believe in association and coöperation, not as a principle of economic comity, but as a necessity of our time, and as an only means of meeting aggressive combinations in other interests.

The contributions, many of them exceedingly well written, show an intellectual status corresponding to the powers brought into play in a calling that is intellectual in its nature.

The Nicaragua Canal.

Captain William L. Merry, former president of the Chamber of Commerce in San Francisco, Consul-General of Nicaragua for the western section of the United States, has under the auspices of the Chamber of Commerce and the Board of Trade, in San Francisco; the Chamber of Commerce, Portland, Or., and the Chamber of Commerce, San Diego, Cal., prepared and published an essay on the subject of the Nicaragua Canal that comprehends fully the political, commercial

and engineering phases of this great enterprise.

Captain Merry was the first to urge on this Coast the commercial importance and relations that a trans-Isthmus canal would have to the industrial future of the Pacific side of the country, and was well prepared to do so, from the fact of having spent many years of his life on the Isthmus, or in command of vessels going there; also by reason of three years spent as the agent for the Nicaragua section of the Central American Transit Company's business, during which time he practically lived on the line of the proposed canal, going over the route by night and by day in steamers, boats and canoes, so the canal route, as Captain Merry remarks, is as familiar to him as California Street in San Francisco.

For notice of the present work we can only say it is an epitome of all documentary data relating to the subject, besides original and interesting essays on connected or corelated subjects, arranged in an orderly manner and embellished with photo-plates to explain various conditions of a physical or geographical nature pertaining to the route.

Captain Merry has divided his subject under the following heads: "The Commercial Necessity of the Canal."—"Its Description and History."—"Its National Importance."—"The Problem of Cheap Transportation."—"The Position of the Railways in Respect to the Canal." Of these several sections we cannot spare space to notice more than one, that relating to railways.

It is common in this country to ascribe to railway management and policy a very high order of sagacity, and there are also a few people, and, as it happens, men of much ability, that claim railway management to be stupid in many cases, and confined to a present policy and circumstances.

Captain Merry points out the railway dread of the Sault Ste. Marie Canal, connecting Superior with the Great Lake system, and how the result of this canal has been to vastly increase the railway business, instead of injuring it; also that the Erie Canal has likewise increased the parallel railway business.

He also points out that twenty-five years of trans-continental connection has left the Coast in a most undesirable condition in respect to all of its industries and interests. The business and aim seems now to be to carry to and supply the Pacific Coast onthe assumption that trade cannot move the other way, which means that a short haul is not as profitable as a long one. Mr. George Dickie says the merchants build their houses here opening to the sea and to the world, and then look through the back doors inland for business. The railway people have got no farther.

There seems no need of Nicaragua Canal literature beyond the present work, unless it relates to method, and even this phase is now fairly before Congress and the people of this country. Copies of the work can be obtained by addressing the author, or the Secretary of the Chamber of Commerce, San Francisco.

The Moon, As Seen by a Geologist.

This is a publication by the Astronomical Society of the Pacific Coast, a translation by C. A. Stetefeldt of a late essay by Prof. Edward Suess, of Vienna, Austria, under the title above given.

It is a learned paper that has met with wide and welcome reception among scientific people in all countries, and is here ingeniously condensed in English, and made even plainer than the German text by the able translator, who has done a deal of honest hard work in the case, as one must conclude.

It is a curious thought and fact that the surface of the moon should be laid out and named like a county in Illinois, but this is merely observation by powerful instruments and concurrence of different observers, but when, as here, it comes to an attempted physical analysis of our satellite, over 2,000 miles in diameter, and 250,000 miles away, it looks like prying into secrets not intended for people on this planet.

From a fine plate, bound in the Bulletin, taken at the Lick Observatory in 1891, one must conclude that the crust of the moon lacks a good deal of agricultural adaptation. The present essay deals with this matter, and contains the most that is known of the moon, perhaps as much as will ever be known.

Copies can be obtained from the Secretary of the Astronomical Society of the Pacific Coast in this City.

LOCAL NOTES.

At the regular meeting of the Technical Society of the Pacific Coast, held at their rooms on the 5th of last month, Mr. E. S. Cobb, member of the Society, presented a paper called "Notes on the Construction of a Wrought Iron Wheel." The method of construction illustrated and treated upon in the paper corresponds to the diagrams published in our last issue. The subject was discussed by the members at some length, and a good deal of interesting information was elicited from the speakers. The next meeting, to be held on the 4th of October, will be an informal one, and include a dinner at some place in the City, not determined at the time of writing this. Of this it it may be remarked, that in this country associations of the kind are commonly utilitarian in a degree that impairs their usefulness and interest, and a "departure" now and then, conduces to the general objects in view, that of promoting intercourse and coöperation.

There is in this State, now especially in the southern counties, a rapid change from coal to oil for fuel. The commercial difference measured in heat units and money is about as two to one, due mainly to the discovery in the Los Angeles district of numerous oil wells. The Southern Pacific Company are adopting it for their locomotives, and have a large number now equipped, the Southern California line having twelve fitted for oil. The margin in the price of oil will gradually disappear, until the oil interest is "controlled." The experiment made some years ago with the steamer *Piedmont* failed because of the imperfect methods of burning the oil, and the fact was not creditable, because no such difficulty existed elsewhere, and oil had been regularly burned on steamers in the Russian seas, and also on land there, for many years. We examined a collection of oil burners exhibited here about two years ago, and a conclusion was that the whole of them belonged in the scrap heap. Those on the *Piedmont* burnt the rivet heads off the boilers.

The Union Iron Works are now constructing a passenger ship for service on Lake Tahoe, a twin-screw boat 150 feet long, to accommodate 150 passengers. This vessel is to circumnavigate the lake daily, calling at various parts with mail and passengers. This, and the steamer to ply between Rio Vista and Sacramento in a similar business, a new packet or two to Vallejo from this City, and some other river schemes, indicate that some attention is being directed to water carriage of passengers. The traffic from here to Vallejo, about thirty miles in deep inland water, would any where else be done by steamers. The railway is indirect, and requires with ferriage about the same time as a boat, while the comfort is all on the boat's side.

A reported coalition of some kind between the Westinghouse Electric Company and the Baldwin Locomotive Works is a significant matter in respect to the possibilities of electric transmission on railways. The Westinghouse companies for twenty years past have without much error predicated their business plans on future wants not yet called into practical existence, and have in so doing become leaders, and prospered accordingly. About ten years ago the brake company began preparing for the application of their system to freight cars. It was not in use then except on passenger cars, but that made no difference. It was a guess at the future, the result of which all know. Their early insight respecting the Tesla inventions is another case.

Just after writing the above we received notice from the Westinghouse Machine Company of their having acquired the patents of the Hon. C. A. Parsons in this country on his impulse engines. Mr. Parsons' agent in England had apprised us at the beginning of last month of a contract being completed with an American firm, but not the name. We guessed at two firms, Messrs. William Sellers & Co., of Philadelphia, and the Westinghouse Company. "INDUSTRY" has been almost alone in its efforts to create interest in impulse steam engines in this country, and it is of course a pleasure to have such confirmation of our views. It will, as we believe, add one more case to the successful predictions made in respect to the success and failure of new things. If there has been a "miss" in eight years past we do not recall it.

There is made here in San Francisco excellent saw-mill machinery of various kinds, which is sold as cheap as it can be procured in the East, but many of the mill men prefer to import their machinery, and in some cases orders given at the East have actually been transferred to firms here to be executed. Logs 72 inches in diameter were a little too much for the Eastern idea of a saw mill. The Sanger Lumber Co., a large mill-owning company here, imported, some time ago, an Eastern band-saw mill with immense wheels nine feet in diameter, one of which proceeded to scatter itself all over the premises, wrecking the mill in various ways. The company substituted this machine with one made at the Vulcan Iron Works, in this City, having eight foot wheels that saws, as the president of the company admits, ten per cent. more timber. The Vulcan mill is 25 per cent. heavier than the Eastern one with the larger wheels, and is in every way a superior machine at the same cost. The Manufacturers' Association can make a note of this.

At a conference between the Mechanics' Institute and the Manufacturers' Association the subject of taxation was discussed, many of the members claiming that the manufacturers should have exemption for tools, plant, etc. The subject is not a new one, on the contrary is quite old. The manufactures of Philadelphia were to a

great extent founded by such a policy that is more than a century old, but some years ago when Cleveland, Minneapolis and some other cities attempted to carry out the "Penn system" it could not be done. It prevented or hindered land holding for speculation, and the speculators conquered. The principle is logical and just applied to all productive pursuits. Matthew Bolton said to William Pitt, the English Premier: "Tax wealth wherever found; tax the spending of it, but for God's sake do not tax the 'getting' of it." That is the whole philosophy in a nut shell, applicable to all industries.

The Vulcan Iron Works, in this City, make a special business of constructing aerial rope ways in all kinds of inaccessible places. A plant is now being made to transport 60 tons of ore a day for a mining company in Montana. The company have sent a lot of mill work on an order from Guatemala, and a heavy band-sawing machine to a timber company at Fresno. Most of the machine works in San Francisco are now well employed, with a promise of continuance through the season.

The Fuel Committee of the Manufacturers' Association has been investigating the Pittsburgh Coal Mines, in Contra Costa County, or as we may say, on the north side of Mount Diablo, and find plenty of coal, facilities for shipment and willing buyers, but do not explain why the business is not more extended. There is plenty of coal under or in Mount Diablo, and its approaches, but the country was made on the convulsion plan, and the stratification is bewildering, rendering the costs and risks of mining excessive.

Thomas H. Leggett, the successful manager of the Standard Consolidated Mining Company, at Bodie, Cal., resigned his position in July, and has accepted an offer from an English company to proceed to the Witwatersrand, in the Transvaal, South Africa. The large number of American mining engineers that have received appointments abroad during three years past is an indication of the advance made in methods here, especially in mechanical departments and processes, and in the organization of practical work. It is not pleasant to lose such men as Messrs. Hammond and Leggett from the activities here, but it is the way of the world that insists on free trade in service and a duty on the products. Mr. Leggett's success in practically redeeming the Standard Mine, at Bodie, has attracted much attention everywhere.

The San Joaquin Electric Co., at Fresno, have partially completed works for utilizing the water power of the North Fork of the San Joaquin River and some contiguous streams, and will transmit by electric current to Fresno about 1,500 horse power at the beginning, to be increased up to 8,000 horse power as a market and purpose is developed. About one hundred men are now at work on the

plant, which has been erected under the charge of Mr. John S. Eastwood, C. E., of Fresno, a very competent engineer. The water is taken out without a dam or head works, beyond a simple intake. The distance of transmission is long, 35 miles. The current will be raised at the power station to 11,000 volts, and at the terminal transformer to 700 volts. The main wire will be of pure copper, No. 3 gauge. This is a work in progress, so may be mentioned and commended. The investment will be $200,000 or more, and if all the current can be sold the investment will no doubt prove very remunerative.

In this issue we reproduce a portion of a late paper on Gas Engines, by Mr. G. E. Stevenson, C. E., that forms a complete technical history of these engines for twenty years past, or since their advent in a practical form. We have been waiting some years for such an essay, and are glad to republish it because of the large interest in gas-engine making and their extended use here.

There is now, and always has been, opportunity for competing with the great railway company for the traffic of the valleys here in California, but it is not by building standard gauge heavy lines that can become an integral portion of the old system as soon as the stock can be acquired or controlled. The gauge of the local valley lines should be different, narrow and cheap, so it could not be absorbed, and for farther reasons. A line from Petaluma to Healdsburg, Napa to Calistoga, or from tide water back in any of the fertile valleys, would return a profit from the start. The same remark might apply to the San Joaquin Road, now building. One at half the cost would have done the required business, or if not, two so constructed as to be non-absorbable, but if there is intention of overland connections this would not do. We are speaking of local railways to reach back from tide water through the principal valleys.

The Union Iron Works here are constructing a number of steel barges of 500 tons displacement, to be used on the Amoor River, in Siberia. These barges will be made in sections, so as to be shipped on vessels and put together after their arrival at the Amoor country. They are to be used in the transport of material for the trans-Siberian railway. The company are also constructing two large steel barges for the Pacific Mail Steamship Company, to be used for storing fuel and freight at some Central American port; also some steel lighters for use on the same coast. The company also have instructions to build a steamer 200 feet long to ply on the Amoor River. This, with an oil tank steamer, and one for Lake Tahoe, makes up a large amount of business to supplement the lull in Government work, of which $10,000,000 worth has been constructed at the Union Iron Works.

There is, perhaps, no other city in this country, or in the world, that would permit the erection of such a shot tower as is proposed for the corner of Market and Third Streets, in San Francisco. It is in architecture, and its effect on surroundings, an ostentation, a display of money power and a disregard of various interests, public and private. In Paris and Vienna, also in upper New York, can be seen the effect of intelligent control over architectural vagaries. No one doubts the practicability of the Spreckles structure any more than they did the Eiffel Tower, nor the commercial expediency of the thing measured in rents, but it will be, like some buildings now erected, an eyesore in an aggravated degree, rendered possible by an admiration of the marvellous and a disregard of public taste.

Some recent observations around the thermal springs in the Lake County Basin lead to the conclusion that the minerals held in solution are derived from infiltration through vast deposits thrown up by volcanic action, and that the temperature is a result of chemical reactions. This may all be old and well known, but the exposure of the mineral matter, that is the white or chalky deposits, are sure to be over or in the vincinity of the springs, in some cases covered by forest growth or top soil, but generally exposed somewhere. The whole country seems to have been a nest of craters, the soil disintegrated lava, and in some places resembling the slag dump of a smelting furnace. There are besides many physical evidences of volcanic disturbance. Great springs of water near the mountain tops in some places, and in other cases no water at all at the surface, but boiling springs opposite in the lake, indicating subterranean passages at a great depth.

About four months ago "INDUSTRY" ventured some predictions respecting the mechanism of what are called the Sprague-Pratt electric elevators, that have a screw and ball-nut bearing to operate a set of Armstrong pulleys. We want our mechanical friends to keep this in mind and see what the future brings forth. The general construction and arrangement of the machinery for these elevators will form the theme of a future article. At present we desire only to call attention to the ball bearings on the main screw, and to ball bearings in general, except for light pressure or intermittent use. Our contention is that the gearing of the elevators above named is a controversion of established good practice, and cannot "endure."

Mr. I. M. Scott, of the Union Iron Works, has gone to Japan, no doubt to secure, if possible, contracts for shipping, and there are strong probabilities that he will succeed in so doing, especially in the case of vessels of special construction. There is no doubt that the engineering and skilled resources of the Union Iron Works outrank any of their Eastern competitors, and unless the price of steel and

other supplies is increased here there is no reason why Japanese contracts cannot be secured in this country as well as in England. Our natural markets for this Coast are in Asia, where our breadstuffs and surplus food must be sent soon, or not sent at all. We are on the Asiatic side of this continent, and to the east are only countries with all and more skill in most pursuits than exists here, and to whom we cannot sell, but to the west all is different. Some of our able business men are beginning to discern this, among them President Hill, of the Great Northern Railway, who may place here a large order for steamships to connect his railway with Asiatic and Australasian ports.

COMMENTS.

A correspondent of a Chicago paper writing from Tokio, Japan, says that when water pipes for that city were required a foundry plant, costing $300,000, was bought and set up to make the pipe on the ground. A young man from this country, a graduate of the Troy Polytechnic School, who had never seen such work made, was put in charge, and some worthless pipes were produced at a cost of $80 per ton. Then bids were called for from various countries, several firms in the United States were asked to tender, but only one firm in each of the other countries. Bids from here were lowest and acceptable, but the makers refused to deposit ten per cent. of the amount as security for fulfilling the contract, and it went at a higher price to Belgium. Another call for bids on 14,000 tons of pipe was sent here, and an Alabama bid was much the lowest, but stipulated the pipe must be paid for before it left this country. Of course no pipe was made here. No one in Europe questioned the terms or the good faith of the Tokio Government, or asked for other terms than were stipulated, so we lost this important work.

The American millers have nearly captured the Brazilian market for flour, owing to a discriminating tariff placed on Argentine flour, imposed in retaliation for certain taxes on Brazilian sugar. Brazil was formerly the chief market for the Argentine flour mills, which have a capacity of 1,345,000 tons a year, requiring 2,000,000 tons of wheat. An effort is to be made to repeal the reprisal tax in Brazil. There is no permanence in markets thus controlled.

The people in British Columbia are naturally endeavoring to direct to their country some of the millions of money that the British people are now sending into Africa for investment in mining property. The idea is logical and reasonable, because there is no doubt that our northern neighbor has opportunities quite as good and more permanent than exist in South Africa, not only in gold and silver, but in other minerals, including coal. A "run" to

investments in British Columbia could not fail to be of advantage to this Coast, all over, and especially to California, by increased trade, and bringing the mining interests here to notice for one thing. The European investor is timid, and if British Columbia had not known Fraser River and Cariboo the chances are that millions of money would long ago have found its way into British Columbia's industries. The country has settled down now, and there will be no more such fiascos as those above named.

The Phosphor Bronze Smelting Company, at Philadelphia, have engaged in the manufacture of "delta metal" under the English patents in this country, and reports of its qualities are amazing. It has a strength equal to fine steel, is non-corrosive, and can be forged, welded or cast, and is suitable for use over the whole field of construction, where its price will admit. The progress made in alloys of metals during twenty years past would form an interesting theme, and a useful one, if treated in a book devoted to this subject.

The *Columbia* on her trial trip run from England to this country made about 18.5 knots an hour under conditions that might be called fast cruising speed. There were the usual mishaps of one kind or another that seem inseparable from war vessels, but on the whole, and comparing with other vessels, the run was creditable, but does not prove that she can catch merchant steamers at pleasure. It is not desirable that she should, or that any other steamer should do so, and it is not likely that ever such a thing will be called for.

The Dominion Government have a tariff to some purpose. The Canadian Pacific Railway, which one would suppose could do as they pleased, recently purchased some steel rails in this country, and had to "rise and explain." A bill was presented to the Parliament, at Ottawa, prohibiting railways from purchasing from aliens, but was withdrawn by a promise of the Minister of Railways that it would not be done again, or at least bids from this country would be ignored. This the friends of protection everywhere should commend, but it would be hard on the revenue.

There will be presented for action before the next Parliament in England an important amendment of the patent laws in that country that will have much interest here. The points of the new Act briefly stated are as follows: (1) Prior publication in Great Britain will not debar a patent provided the publication is inadvertent, without the knowledge or consent of the inventor, or the matter was not derived from him, and provided he uses due diligence in presenting his petition. (2) Provisional specifications can be amplified by additional developments and improvements while

pending. (3) Disconformity between a provisional and complete specification shall not affect a patent after it is granted. (4) No precedent more than fifty years old will be evidence against novelty. There are other provisions of less importance in the Act which need not be quoted. On the whole it seems logical and expedient.

The Council of the American Society of Mechanical Engineers have out of the unusual esteem in which the late president and colleague E. F. C. Davis was held, issued the following tribute to his memory:

"The American Society of Mechanical Engineers desires through its Council to spread upon the records of the Society and of its Council a minute expression of the respect and regard which its members feel and seek to make public upon the sudden and untimely death from an accident of their colleague, Mr. E. F. C. Davis, President of the Society. The formal mould of memorial resolutions in which a corporate body ordinarily records its action seems inadequate for a proper voicing of the spirit which pervades the Council in the presence of the death of one whom its members had known so well, and whom they had learned to admire and love. His wise and mature judgment, his business and professional knowledge, his conservative yet energetic counsel, and his courteous consideration for others, had made him one from whose administration of the Society's affairs the highest hopes had been entertained. Although with such grief the outsider intermeddleth not, yet the Council would presume to express their heart-felt sympathy with those nearest and dearest to Mr. Davis, upon whom this blow has so crushingly fallen."

No more touching tribute could be paid to a man, and certainly no one could better deserve it. Mr. Davis met his death by an accident in August last while in vigorous health and the pursuit of his professional duty.

In the Act of Congress providing for carrying foreign mails in American vessels, passed in 1891, the requirement is that first-class vessels must have a speed of not less than 20 knots an hour. The *St. Louis*, under the inspection of Government officers, has made a test run in the English Channel, where there are defined marks, and attained a speed of 22.3 knots, and of course exceeds the requirements. This is creditable and gratifying to both the owners and builders.

In the year ending June 30th, 1895, there were filed in the United States Patent Office 36,972 applications for patents on inventions, and 20,745 patents were granted. 2,314 caveats were entered, and 2,182 applications were made for trade-mark registration, but only six cases under the head of "prints." This latter has nearly ended as a branch of Patent Office business, and the Act should be

repealed. The design applications for the year numbered 1,453, and re-issues 77. The number of cases that lapsed for non-payment of the issuing fee was 3,208, or nearly one in six out of the patents allowed. The number of cases awaiting action in the Office was 4,927, which seems remarkable, when the work, as stated in the report, is up to within one month in all divisions but one out of thirty-four. Whether there will be legislation in the next Congress affecting the patent laws is doubtful. If the four and a half millions in the patent fund could be "diverted" there would be no lack of attention to that Bureau.

Mr. Forney, the editor and proprietor of the *American Engineer*, while he has been for thirty years past performing a large amount of professional and other duties in connection with technical journalism, has always found time to carry on at the same time some ethical, economical or scientific study besides. The engineering world knows how he has pursued the subject of aeronautics, for one thing. Now he has engaged in a much more practical matter, at least one of much wider import, "proportional representation," and is the secretary to a society whose aim will be to secure a more correct and honest expression of choice in electing officers, and to put this function on a logical and at the same time a mathematical basis. Proportional representation as a principle of political selection is fair, and, as remarked, is logical and mathematical, and for this reason is just what is not wanted by politicians, who wish to represent themselves and their friends. Mr. Forney and his friends will have behind them a formidable array of honest men, and in front of them a barrier such as the Alps presented to Hannibal, but he got over.

Mr. David Lubin, of Sacramento, Cal., has the courage of his convictions, and has been making a tour through the Eastern States lecturing on his scheme of an export bounty on agricultural products. The idea has met with grave attention in various places, and is logical in every way if one starts with protection to other industries for premises. We have no fault to find with Mr. Lubin's views, indeed have derived much profit from reading his essays and lectures, but must think that on the whole, and in a practical sense, the effect will in the end be to equalize conditions by taking off protective duties, and not by adding bounties. It is high time our agricultural interests were represented in the struggle for National patronage and support, but farmers operate independently, and are, moreover, not given to the study of economics, so that Mr. Lubin has had his load to carry almost alone for a long time.

At Philadelphia a large meeting was held at the Maratime Exchange, where Mr. Lubin's views were discussed and approved by strong resolutions, which we have not room to re-produce. The

same thing occurred in other places, as far east as Bath, Maine, where a large meeting of influential men met at the city hall, and passed strong resolutions in favor of a bounty on agricultural products and on shipping. No other event for a long time past will so much instruct people in this thing of bounties, premiums, tariffs, and other kinds of patronage extended to industry, and will in the end lead to the conclusion that as soon as this patronage is equalized it will be of no use whatever to any one. Its promotion rests indeed on the fact of its being partial, and its essence is found in this very feature. If the price of everthing was doubled or quadrupled the relations would be the same, and no one would be poorer or richer for that reason.

For a person who has not been in the maize districts of the Mississippi Valley it requires some effort to grasp the figures that this crop represents in our industrial economy. The crop of maize or "corn," as it is commonly called, is estimated for this year at 2,500,000,000 bushels, or about 212,000,000 cubic yards. It would cover about 7,500 acres ten feet deep, or if in a pile one mile square would be 110 feet high. The crop will be worth this year, at 35 cents a bushel, $800,000,000. The Iowa crop alone would furnish five bushels to each person in the United States. The crop estimate above was made up by the *Times-Herald*, of Chicago, and is, no doubt, correct, but is inconceivable. We can remember, in 1861, when corn for export from Ohio was dried or partially roasted in huge iron cylinders, and it was considered impossible to send it in bulk or otherwise across the ocean without this roasting process; now there seems to be no difficulty of the kind.

The inequality of rates for electric current and lighting is perhaps an accident this far, but it is hard to reconcile with stable business rules. In St. Louis, Mo., the cost of lights is one half as much as in Philadelphia, Pa., but one guessing at the matter would fix a lower rate for Philadelphia than for St. Louis. In Auburn, New York, a street lamp of 2,000 candle power costs $87.00 a year, and in Albany, New York, $182.50, more than twice as much, although it is if anything cheaper to generate at Albany than in Auburn. Some of the rates are as follows: Philadelphia, $177; Boston, $237; Washington, $219. What charter or other regulations may have to do with this variation of rate we do not know, but it must in the future adjust itself to the cost of production.

ENGINEERING NOTES.

Mr. E. B. Ellington, of London, who was the pioneer engineer in high pressure hydraulic supply for cities, has recently in a paper read before the Institution of Mechanical Engineers in England, given some very interesting notes on the progress made in this very important system of power distribution. He has been connected with plants put down in London, Hull, Liverpool, Manchester and Glasgow in the United Kingdom, also with similar works in Sydney, Antwerp and Buenos Ayres. The London system, which is by far the most extensive, now sends out 9½ million gallons of water per diem, under a pressure of 750 pounds per inch, but a much higher pressure than this has been found suitable. At Manchester and Glasgow the pressure employed is 1,120 pounds per inch. At Buenos Ayres the principal use made of the hydraulic power is in lifting and impelling the sewage of the city. The original scheme was laid down by the Hon. C. A. Parsons, the inventor of the steam turbine that bears his name, and has cost in all about $30,000,000.

Mr. Ellington in his remarks, above alluded to, made use of the following comparison with electric current:

"In making the comparison, 1,000 gallons of water at 750 lb. per square inch was taken as equivalent to 6.518 Board of Trade units of electricity. The analyses show that the cost of hydraulic power was 5.172d. per 1,000 gallons pumped at the pressure of 750 lb. per square inch, while the corresponding cost of an equivalent amount of electric energy reduced to the same hydraulic standard was 9.014d. per 1,000 gallons; or on the electrical standard of Board of Trade units, 0.793d. and 1.383d. respectively.

"The output during the year, the capital employed, and the average rates received for both supplies were nearly the same. The coincidence of the figures, as the author stated, was extraordinary, except in the cost items, in which their divergence was equally remarkable. He could draw no other conclusion than that for some reason or other, not hitherto explained, hydraulic power is much less costly to produce than electricity."

The discussion that followed Mr. Ellington's paper was quite interesting, especially the remarks of Mr. Tweddell, the well known hydraulic engineer, who mentioned that at a pressure of 750 pounds per inch, two gallons per minute gave out one horse power, which would for continuous use make the London plants equal to 3,000 horse power, but as the term of use is not more than half the time, or twelve hours a day, the power is double or 6,000 horse power.

Mr. Tweddell said a rule of his that is most convenient to know is that one gallon per minute, at a pressure of 1,500 pounds per inch gives one horse power. This we understood to be independent of, or to include the usual resistances after the water leaves the main pipes or an accumulator. By remembering this one can easily compute for any pressure, for instance, 15 gallons of water would at 100 pounds pressure, equal a horse power, or in any case multiply the number of gallons per minute by the pressure in pounds per inch, and divide by 1,500.

There is to be a trial of the boilers in the two Great Lake steamers of the Northern line, running from Buffalo to Duluth, in connection with the Great Northern Railway. These vessels have Bellville water-tube boilers. The company some time ago considerately placed the ships at the disposal of the Naval Bureau of Steam Engineering, for a test of the boilers in actual service, and Commodore Mellville at once accepted the opportunity. He has now appointed chief engineer Perry and past assistant engineer Norton of the U. S. Navy to conduct the trials, in which however chief engineer Fraser of the Northern Line, and consulting engineer Geo. C. Shepard, of Cleveland, Ohio, will participate. It would have been a fitting thing to have invited Mr. James Howden, of Glasgow. The trial will be a remarkable one, and if successfully carried out will do much to direct opinion respecting the two contending systems for marine boilers, especially as the tests will be under direction of Commodore Mellville with assurance of fair play and intelligent management.

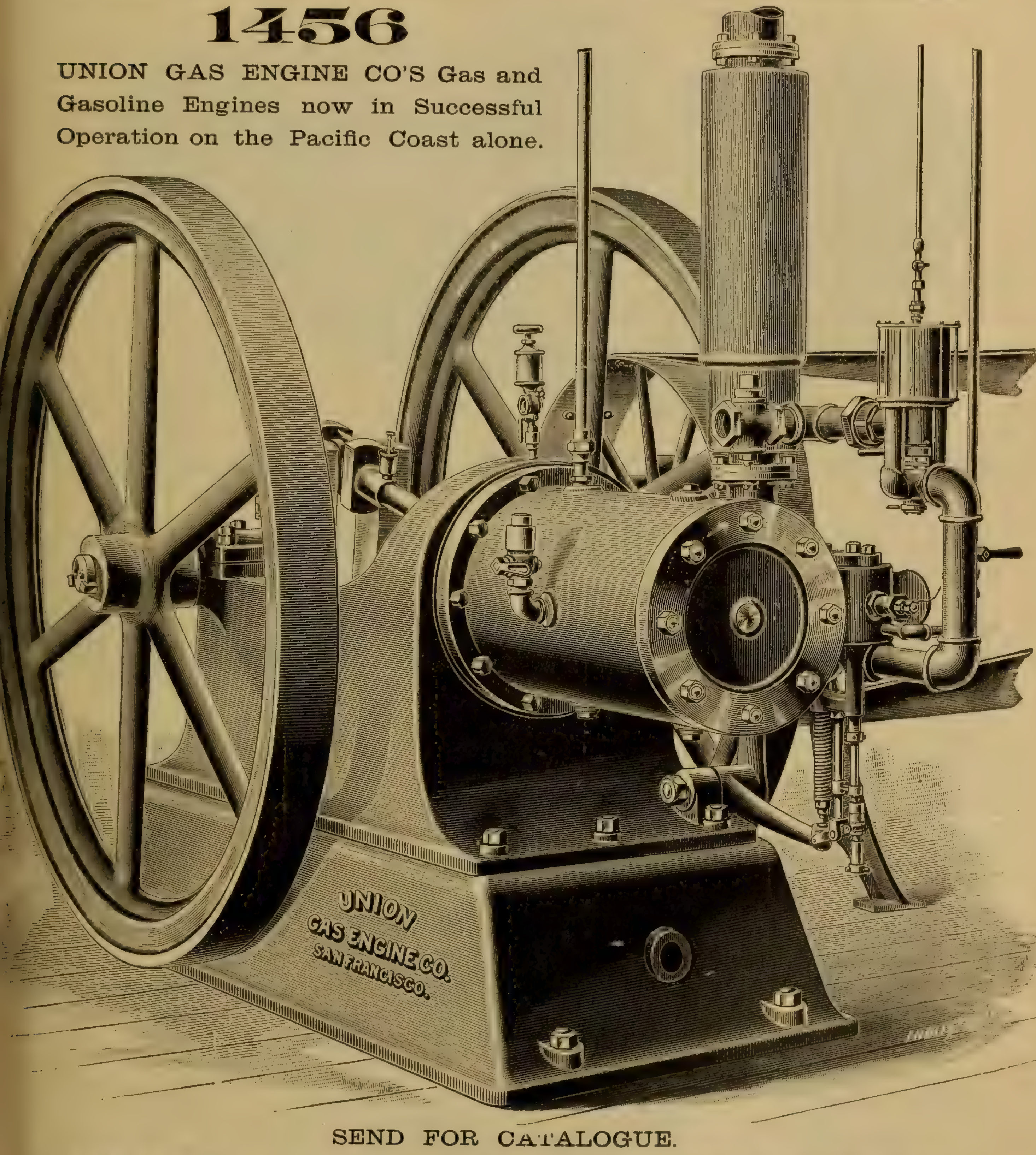
Messrs. H. K. Porter & Co., of Pittsburgh, Pa., have built a number of compressed air locomotives for mining purposes that seem to answer the purpose in an admirable way. A recent one is 17½ feet long, weight 9½ tons, the air tanks holding 130 cubic feet of air when compressed to 600 pounds per inch. These engines are free from the dangers of fire, and electric currents in coal mines serve the purpose of ventilation, and require no incumbrance of any kind beyond the rails they run on.

Mr. Samuel Worssam, of London, has prepared for *Industries and Iron*, an essay on circular saws, that with its graphic part constitutes a contribution of value. He speaks of packing such saws at the sides, a thing that has many times been mentioned in these pages. It consists in wrapping fibrous material around a lath, and inserting one such packing on each side of the saw, in a recess prepared for that purpose. This holds the saw true, oils it and enables the same work to be done with a saw one third thinner than if it is unsupported. From some experience, and a good deal of observance, we must contend that a circular saw is incomplete without this simple

GAS and GASOLINE ENGINES

1456

UNION GAS ENGINE CO'S Gas and Gasoline Engines now in Successful Operation on the Pacific Coast alone.



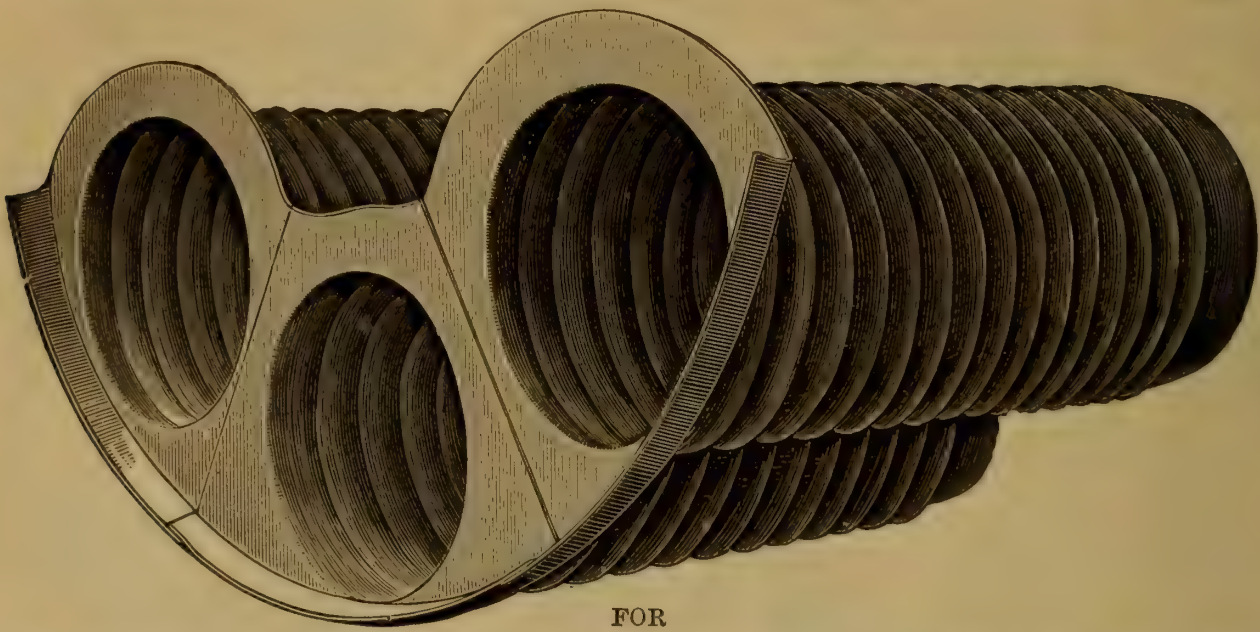
SEND FOR CATALOGUE.

UNION GAS ENGINE COMPANY

309-311 Howard St., San Francisco

Eastern Manufacturers GLOBE GAS ENGINE CO., 22 South 15th Street
PHILADELPHIA PA

CORRUGATED FURNACES



FOR

MARINE and LAND BOILERS

ALSO

MORISON SUSPENSION FURNACES

SOLE MANUFACTURERS IN THE UNITED STATES

THE CONTINENTAL IRON WORKS

BROOKLYN, NEW YORK

THOS. F. ROWLAND, President
THOS. F. ROWLAND, Jr., Treasurer

WARREN E. HILL, }
CHAS. H. CORBETT, } Vice-Presidents

Take East 10th or 23d Street Ferries from New York to Greenpoint.

INCORPORATED 1866

CHARTER PERPETUAL

Insures against Damage to Property, Loss of Life, and Personal Injury

CAUSED BY

STEAM BOILER EXPLOSIONS

J. B. PIERCE, Secretary
J. M. ALLEN, President

ABSTRACT OF STATEMENT
JAN. 1, 1895

Cash Capital,	**$500,000.00**
Total Assets,	**1,955,255.24**
Surplus as to Policy-Holders,	**693,726.15**

PACIFIC COAST DEPARTMENT

MANN & WILSON, General Agents

J. B. WARNER, Chief Inspector

306 Sansome Street - San Francisco, Cal.

and inexpensive attachment. Its omission in American machines is due to the fact that with few exceptions circular saws are employed only for rough work, and in a rough way, a fact proved by saw gauges extending past the saws, which cannot be done when the gauges are parallel to the saw plate.

To illustrate the limitation of human conception, Professor Henry Morton mentions an engraving of the Lord's Prayer, in the Army Museum, at Washington, on a piece of glass covering less than one thousandth part of an inch square, the whole surface being invisible unless as a speck. He computes that on the same scale the whole of the bible containing 3,556,480 letters could be engraved in a space equal to one eighth of an inch in area, or that the contents of the bible could be engraved eight times on one inch square. This is inconceivable, presents itself to the mind when compared with observable facts as an illusion beyond the realms of fancy even. We wrote to Professor Morton to inquire how such minute work could be done, and quote the following from his answer:

"The exact method followed in the microscopic writing made by Webb, of England, is, as far as I know a secret, but without doubt it is accomplished by a machine on the principal of the 'pantagraph,' the secret mainly lying in the method employed to take up 'lost motion' between the parts."

We examined last month a saw-mill boiler that had exploded in a forest mill in Lake County, and from its environment the boiler was most likely not to blame. The flue, of the Cornish type, had collapsed at "both ends," independently, which was remarkable, and as the main shell remained intact, the contents were shot out each way for several hundred feet, killing two men and wounding a third. There were a number of things to think over in the case, one being some means of preventing the use of steam boilers under such circumstances. It was by far too small for the work and had to be excessively fired. The throttle valve was, as is usual in saw mills, jerked wide open and shut. The whole outfit was such as one would expect to see in China, cobbled up in a temporary and dangerous manner throughout, by men devoid of skill, and certainly without much knowledge of steam power.

It is high time that some investigation was made and some information disseminated respecting the steam consumption of direct acting steam pumps, which according to *Power*, produce a diagram like the "cross section of a soap box." *Power* sent to several pump makers recently to find out the steam consumption of boiler feed pumps of the direct acting kind, and received answers giving the amount from 100 to 200 pounds. The makers of these pumps are

not much to blame. They make what people want, and if types more economical were made at any advance in cost, no one would buy them, or at least very few would. The steam consumption at 100 pounds per horse power per hour represents an efficiency of only 25 per cent., and this we suspect is high enough for the common direct acting pump, measured in water raised or forced. The strangest thing of all is that those who purchase pumps of other kinds are particular in respect to efficiency.

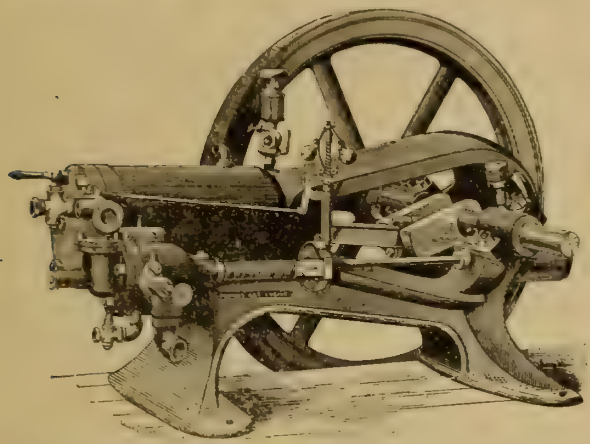
A year ago we contended that in some cases in this country single locomotives with one pair of driving wheels would be desirable, and mentioned the express trains between Philadelphia and New York. One engine of this kind is now in service there, and no doubt others will follow. For easy grades, light trains and high speed, there is no need of two pairs of driving wheels, and the single engines are more simple to construct and easier to maintain. They are used in England for a considerable portion of the rapid traffic.

If the students at Silbey College, of Cornell University, have, as they claim, got a horse power per hour out of ten pounds of steam, with an engine of their own make, it is a most creditable matter. Previous to these tests at Cornell, the Belfast engine of the Victor Coates Co., stood at the head, and does yet as a working factory engine, using 11.63 pounds of steam, and there may be the difference in favor of a careful laboraory test of 1.63 pounds, especially when as in the case at Cornell a very high initial pressure was used. The Belfast engine performance, we should mention, has been called in question and is perhaps wrong.

Our readers will no doubt remember seeing some time ago illustrations of a locomotive set upon rollers, or countershafts they may be called, to increase the circumferential speed of the driving wheels, and such an engine is now being made at Philadelphia for a western inventor. This provides for steam flow, just as larger driving wheels would do, but does not help the main impediment of heating and grate surface in the boiler, and is open to the farther objections of being impracticable on other grounds.

The new interest taken in milling processes in metal work is not by reason of improvements in machines, but because of cleaner and better material that permits the use of rotary cutters. A milling tool is expensive, and while its first cost is small enough in proportion to the work it will do, the price is too great to run the chances of "hand pins" or seams of silica, that once were found in all kinds of rolled iron bars.

Perkins Gas, Gasoline or Oil Engine



Modern, Economical, Reliable in all Situations Requiring Small Power. These engines lead in Simplicity and Low Prices. Send for Engine and Pump Catalogues.

PERKINS PUMP & ENGINE COMPANY

PAUL B. PERKINS, Manager.

117 Main Street, San Francisco.

P. F. CLERC, MACHINE WORKS

Manufacturer of the Best Steam Puffing Irons

Sole M'f't'r L. P. GARCIN'S LIFTING JACKS

LAUNDRY MACHINERY A SPECIALTY.

219 and 221 Main Street, S. F., Cal.

Having been established since 1861, I refer to all the leading laundries of California. REFERENCES: San Francisco Laundry; La Grande Laundry; America of Sacramento; Occidental Laundry; United States Laundry; Contra Costa Laundry.

SCHOOL OF

Practical, Civil, Mechanical, Electrical and Mining

ENGINEERING

Surveying, Architecture, Drawing and Assaying.

OPEN ALL THE YEAR **723 MARKET ST., S. F., CAL.**

A. VAN DER NAILLEN, President.

Assaying of Ores, $25; Bullion and Chlorination Assay, $25; Blowpipe Assay, $10; Full Course of Assaying, $50. Established 1864. Send for Circular.

Asbestos Paraffine Company

Asbestos Roof Paint.
Asbestos Paraffine Paint.
Asbestos Floor Paint.
Asbestos Insulating Paint.
Asbestos Boiler Covering.
Asbestos Stove and Furnace Lining.
Asbestos Grease and Oils.
Asbestos Fabrics, Packing, Etc.

128-130 First Street, San Francisco

GEO. PATTISON & CO.

MANUFACTURERS OF

Alumina Sectional Covering

FOR STEAM PIPES AND BOILERS

The Only Sectional Covering made on the Pacific Coast. Personal Supervision of all Work. Estimates Given.

Office: 32 Eighth Street, S. F.

Patents

Caveats, Trade Marks, Designs, etc.

Report as to Patentability of Invention **Free of Charge**. Unsurpassed Facilities. Moderate Terms. Before Applying for a Patent write us. All information and advice **Free**.

GLASCOCK & CO.

606 F Street, N. W. **Washington, D. C.**

VAN DUZEN STEAM JET PUMPS

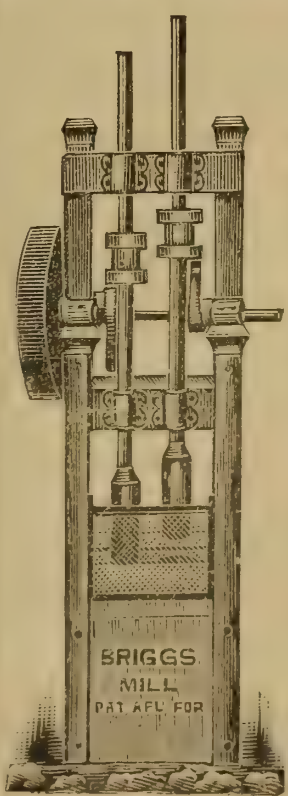
THE BEST IN THE WORLD.

Pumps any kind of Liquid. Always in order. Never clogs nor freezes. Fully Guaranteed. COST $7 AND UPWARD. Especially useful for Mines, Quarries, Pits, Wells, Clay Pits, Breweries, on Steamships, Ferryboats or any place where steam is available and liquid to be pumped. A full supply in stock. Address,

JAS LINFORTH, 37 Market St., San Francisco

THE BRIGGS

2-STAMP MILL



850 Pound Stamps.

Weight of Mill, 6,000 lbs.

Most substantial Mill ever offered to miners; discharge both ends and front; will crush from **six** to **ten tons per day**; anyone can set it up. Complete as per cut.

Price $450.

This mill is furnished with cast-steel shoes and dies, and heavy iron guides.

WESTERN MANUFACT'NG COMPANY

114-116 Mission St., S. F.

Builders of all kinds of Saw Mill and Mining Machinery, Engines, Boilers and Water Wheels.

The great sub-railway in New York, to cost $25,000,000, now projected, is a move in the right direction, in so far as being removed from the plane of surface traffic. Means of conveyance in larger cities must go either above or below this plane; there is no room for both, and as the pedestrians must keep on the surface, the railways must go over or under. They are now a dangerous nuisance in the streets of cities, tolerated only because they are considered a necessity. Some time it will be conceded, no doubt, that the street surfaces of a city belong to the people and cannot be chartered to any one by executive officers.

The Westinghouse Machine Co. find their new and extended facilities were not prepared too soon, all being called into use to meet the demands of the present orders. The principal trade seems to be in compound engines, with an average of 200 horse power capacity. Eight engines of 250 horse power and over were ordered in August, and there is an increase thus far in September.

ELECTRICITY.

The General Electric Company have fitted up a portion of the lines of the Metropolitan Traction Company in New York with an underground or conduit system, on Lenox Avenue, that will no doubt determine the possibilities of this method for other more dense districts of the city. As a matter of fact, and notwithstanding long essays by electricians on the impossibility of an underground system, there is no impediment but cost, and as the fare cannot be raised above five cents the whole matter is one of investment and earnings. The Siemens & Halske Company have constructed successful lines on the conduit plan, that have for many years past performed successfully, and it was only after there was no hope that trolley wires would be permitted in New York that the present experiment was entered upon. The wisdom of not permitting the use of overhead bare wires in New York will become apparent some day.

The "pneumatic" part of the great power plant at Salt Lake, or in Cottonwood Cañon, has been succeeded by some tangible progress. There is an aggregate of 2,500 horse power to be conveyed fourteen miles to Salt Lake City, where the whole of the current can be sold. The Ogden enterprise of a like nature seems to have died out, but will come up again no doubt when the promoters have finished their part, and some business people with money will assume the work.

A New York electrical journal says that any one who talks of applying storage batteries for traction purposes is either a knave or a fool, which is a tolerably strong opinion, if opinion it be. We

suspect it is paid for as "trade talk." Storage batteries have been in use for traction purposes for ten years past, and like Mr. Dudgeon's engine "continues to go." The storage system, no matter what its merits may be, will have to make headway against the opposition of the electric companies. It is like a water meter, all right when it counts against the consumer, but all wrong when it acts against the purveyor.

The Occidental Hotel of this City, is now being fitted with a complete electric lighting plant, by the Union Iron Works and the Siemens & Halske Company, and so far as completed, which is almost entirely, there is a method and system that shows careful and intelligent skill. The engines and generator show a high class of workmanship, evidenced by almost noiseless operation, and the wiring with all accessories, as remarked before, show a systematic and complete plan from the beginning. Mr. Ridley, of the Siemens & Halske Co., is employing a new form of arc lamps, that give 24 hours service with a carbon of the usual length, operating on some method that was not explained. It seems to be an improvement of considerable importance in several ways and will be explained in a future issue.

The Siemens & Halske Company, of Chicago, are steering their way to electric locomotives, that is, are making steam ones, and have just completed the first engine of 192,000 pounds weight, for the Burlington and Quincy Railway Co. In acquiring the Grant Locomotive Works, the Siemens & Halske Co. of course came into possession of a complete outfit for this line of work, and it seems are now operating this department vigorously under the new organization which Americanized the works by the accession of a larger amount of local investment. The shabby treatment of the Siemens & Halske Co., at Chicago, in 1893, will operate in the end like the Arab proverb about the chickens that "came home to roost." Their work that has came here to San Francisco indicates an abilty that we can well afford to welcome.

It will, in a sense, be an assumption to claim that the large number of recent essays on the subject of electrical impulsion of railways, are not without some logical base, but discussion of the subject by Mr. H. G. Prout, Dr. Duncan and others, is certainly to be set down as generalization rather than an examination of concrete facts. The progress made in actual work, as in the Baltimore tunnel, described in the last issue, and the arrangement of a branch of the New York and New Haven Railway for electric propulsion, proves the existence of conditions where the method is not only admissible, but suitable, still, the limit of distance is not being extended. It will not be wrong to say that the data that now exists is by no means enough to permit much beyond speculation, and opinions are

in a sense *ex-parte*, but very soon the subject will be taken up by railway and mechanical engineers, and then some determined conclusions can be reached.

A branch of the New York, New Haven and Hartford Railway, seven miles long, extending to Nantasket Beach, has been fitted up for electrical service propulsion, and the result in so far as service seems to be wholly successful, but from a description of the equipment we think it will be some time before there is much extension of the system, because the cost is beyond the resources of most railways of our day. The motors are of 100 horse power, four being employed on most of the cars, two on each truck. The power plant, wires and poles, with other equipment, must have cost a large sum. There are six feeder cables, each containing 49 wires in seven strands of seven wires each. No information has been published in respect to either the first cost or the working expense, from which we may infer that neither of these are favorable, otherwise the figures would have been heralded with much vigor by the electrical journals. The Pennsylvania Company are operating their Mount Holly branch by the trolley system, and there are some other cases, but no figures.

MINING.

NOTES.

It is reported that the nickel mines at Lovelock, Nevada, are about to be opened by an English Company who have bought the property and have erected a reduction plant at a cost of $75,000. The sale of the mine is contingent upon the success of smelting the ore, which we much hope will succeed. The former owners, Messrs. C. T. and W. S. Bell, are themselves experienced men in smelting operations, and would long ago have developed the property if they could have enlisted the required capital for this purpose.

Dredging for gold in British Columbia has been much like dredging in California, not very satisfactory, and as inferred from several comments in the *News Advertiser*, for the same reasons — want of proper apparatus and skill. It is pretty hard to complain of inefficient machinery, however, when no one knows just how such machinery should be constructed. One idea must be abandoned, that of mining a fortune in a few days or weeks. This will not happen any more than it does in other kinds of mining.

The Anaconda Company, at Butte, Montana, are we are informed about to adopt the electrolytic process of smelting copper, and will employ current to the amount of 8,000 horse power. Some experiments going on have confirmed the expediency of this change,

which is as extensive as important. The work of the Anaconda Company will require nine generating plants or units, which will be furnished from this City no doubt, where the other new work for this great enterprise is now being constructed. This work, including hoisting and mill engines with electrical apparatus, is all of very high class. This trend toward electric smelting is not confined to this country. Dr. de Laval, of Stockholm, Sweden, the inventor of the steam turbine that bears his name, has made, as he believes, inventions in electric smelting, that will permit the process to be applied to iron and steel, and is now putting down a large plant for that purpose, using water power to generate the current.

The mention of a hoisting speed of 1,700 feet per minute in a Hungarian mine, in our August issue, has called out some interesting facts on this subject, showing, as one of our compositors says, "Hungary is not in it." The following communication has been received from Mr. W. M. Ruth, of the Edward P. Allis Co., of Milwaukee, Wis.

To THE EDITOR OF "INDUSTRY." *Sir:*—The August number of "INDUSTRY" contains an item on the hoisting speeds employed in a Hungarian mine. A speed of 1,700 feet per minute, 19.3 miles per hour, is reported. At the Tamarack Mine, in the Lake Superior copper region, thirty-nine cars per hour were recently raised from a depth of 3,180 feet for six consecutive hours. This is equivalent to an average hoisting speed of 3,180 feet per minute, or 36.1 miles an hour, allowing a trifle over one minute for loading and unloading the cages. The load of rock was 6,720 pounds. This work was performed with a direct-acting or first motion hoisting engine made by the Edward P. Allis Co. The steam cylinders are 42 × 84 in., and the hoisting drum 30 feet diameter. It has been in service several years. At another shaft owned by the Tamarack Mining Co., a trip was made some days ago, from a depth of 4,500 feet in one and one quarter minutes, equivalent to a speed of 3,600 feet per minute, or nearly 41 miles an hour. At this shaft, the engine, which was also built by the Edward P. Allis Co., is 32 × 84 in., and the hoisting drum, a double cone, 13½ ft. and 36 ft. diameter; each cone will carry 6,000 feet of rope. For short periods speeds as high as 4,200 feet per minute have been observed.

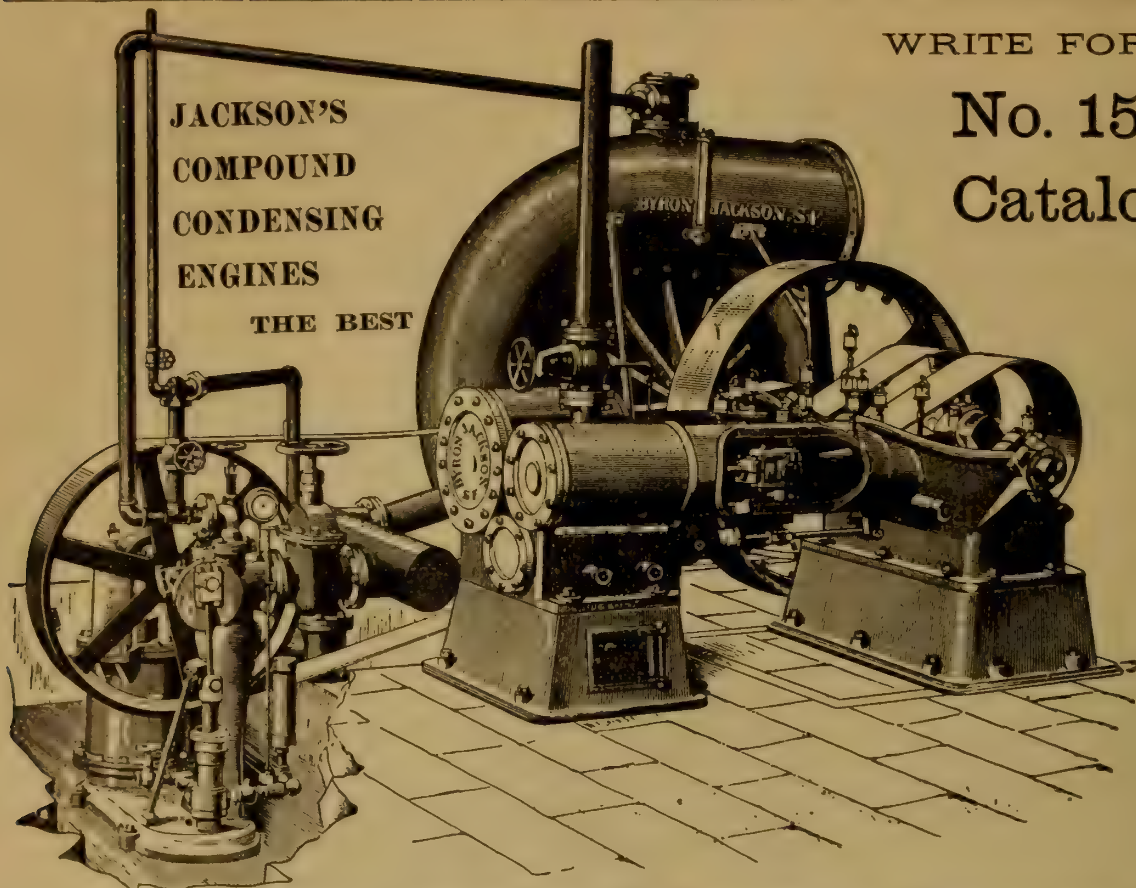
Milwaukee, Aug. 24, 1895. W. M. RUTH.

These speeds are terrific. At 4,000 feet per minute it equals 45.45 miles an hour, but is not camparable to a railway train at this speed, because both starting and stopping are included. The middle or maximum velocity must reach at least 50 miles an hour, perhaps more.

Now that rapid hoisting is a topic, we will mention a report that at the Diamond Mines, in South Africa, over 5,000 tons of material was raised 1,300 feet in 11 hours and 44 minutes, nearly 450 tons an

WRITE FOR

No. 15 Catalogue.



JACKSON PUMPING PLANT FOR IRRIGATING AND RECLAIMING LAND.

Byron Jackson Machine Works

625-631 SIXTH ST., SAN FRANCISCO, CAL.

BUILDERS OF

COMPOUND CONDENSING ENGINES

AIR PUMPS AND JET CONDENSERS.

Pumps for Irrigation and Reclamation, Dredging, Wrecking, Mining, and City Water Works.

BOILERS

AND

ANY KIND OF MACHINERY BUILT TO ORDER

These pumps are intended for mine pits or deep wells, and will operate when submerged. The glands and inlets are sealed by water to give full power of the suction. The alignment of parts and for adjustments is perfect. The runner has balancing rings, and sustains the running weights by water pressure, and dispenses with a bottom bearing below the runner. All parts are removable from the top. These are all patented features, and found only in these pumps. The superior efficiency of these pumps has been demonstrated under all conditions of use, and they are sold subject to the broadest of guarantees as to efficiency and durability.

Jackson's Vertical Water-Balanced Runner and Shaft "Whirlpool" Centrifugal Pump.

hour. The velocity is not given, but as the loads were 1,600 pounds, there were 625 trips of 1,300 feet, which produces a continuous speed of about 1,000 feet per minute one way, or double that for both ways, up and down, if only two hoists were in use. This allows no time for dumping or loading, and needs division by two at least to come within any hoisting thus far heard from. The report says "from one shaft," but certainly there were four or more hoisting compartments.

Mr. A. B. Paul, of this City, in the *Mining Press* points out a want of enterprise in mining matters here, and contrasts what England has done in a distant and inhospitable country during the past nine years. He says that in South Africa, where 40 millions of gold will be produced this year, the British people have spent 134 millions of investment, and have taken out 116 millions of gold; also that the same enterprise is manifest in other mining countries, except in California and Nevada, where exists greater natural opportunities than anywhere else in the world. This may all be true, but there is an impediment here to investment, and also to enterprise. Capital is in less active hands. Men here possessed of large means are apt to be without much enterprise, do not need to be as they reason, and every year the command of capital and other essentials of public enterprise grow more difficult to command. The hiring of skilled men here for the South African mines shows the vigorous state of things.

The competitive test with crushing and concentrating machines in the Bullion-Beck Mining Company's mill, at Eureka, Utah, has been concluded after a run of four months, and the result has been in favor of the Bryan mill and the Johnston concentrators. This test, of which we have no particulars, has resulted in the company adding a new crushing machine of the Bryan type and four more of the Johnston concentrators from the Risdon Iron Works, in this City, where the machines are made. The Bryan or Chilian type of machines combine with pressure a mascerating or "twisting" action on the ore that seems to add a good deal to the effect. The same action, but in a limited degree, is produced by the rotation of stamps caused by the toppets.

There is, we are informed, likely to be contention and suits at law over the Johnston concentrator patents, which there seems to be a tendency to infringe. These patents relate to the movement of the concentrator table and belt, which is indescribable in a geometrical way. It is a resultant of several motions, a side "shake," and a compound oscillation or "undulation," it may be called, produced by the arcs of suspending links at the sides, producing a motion like that given to a hand riddle or a batea. The peculiarity is that diagrams taken from various parts of the table, between the center and

side, do not correspond. Oscillation means technically reciprocal movement in the arc of a circle, but that in the Johnston concentrator is something else. We once spent some time over this matter, but gave it up, name and all.

The Treadwell Mine, at Douglas Island, Juneau, Alaska, crushes and treats ore for $1.37 per ton, pays $3.50 a day to 170 white workmen, and $2.00 a day to 30 Indians. Last year nearly 250,000 tons were milled or treated at a profit of $1.28 per ton, or over $300,000 for the year, amounting to six per cent. on the investment or stock. The mill has 240 stamps, and is the largest in capacity of any in this country. It was built by the Risdon Iron Works, in this City, in two installments, and is designed on the California model. To crush this large amount of ore, three to four tons a day for each stamp, the ore must be soft and the gold free, with plenty of water and power. These conditions exist at the Treadwell Mine, which is on tide water near the City of Juneau, and in every way, except freezing, a most comfortable place for working.

The flooding of two mines in Colorado, and the loss of fourteen lives, on the 29th of August last, should afford a lesson to those engaged in mining everywhere. The Fisk Mine, adjacent to the two flooded at Blackhawk, had been abandoned and filled up with water, which burst through into the Americus and Sleepy Hollow Mines, drowning the miners before escape was possible. The head of water pressing on the walls dividing the mines was about 400 feet, if the Fisk Mine was full, equal to a pressure of more than one ton to each square foot at the bottom, so that a heading or wall ten feet square had to withstand a lateral pressure of a hundred tons. In solid rock it would not require much thickness to endure even this tremendous pressure, but there is always danger of breaking through fissures, and by mistakes of surveying, or no surveying.

Mr. James Houlehan, of Chicago, who discovered the magnetic properties of gold, silver and other metals classed as non-magnetic, has been at Telluride, Colorado, and contracted to erect a plant to operate upon his methods. One mill to treat 125 tons a day has been erected, and people are watching the result with much interest, The stories of treating ores at a few cents a ton, when the only new feature relates to final extraction, are of course impossible. It costs something to prepare ore for this or any other process.

No. 88. NOVEMBER, 1895. Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor Founded 1888. W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

WASHBURN & MOEN M'F'G. CO.

WORKS:

WORCESTER, MASS. WAUKEGAN, ILL. SAN FRANCISCO, CAL.

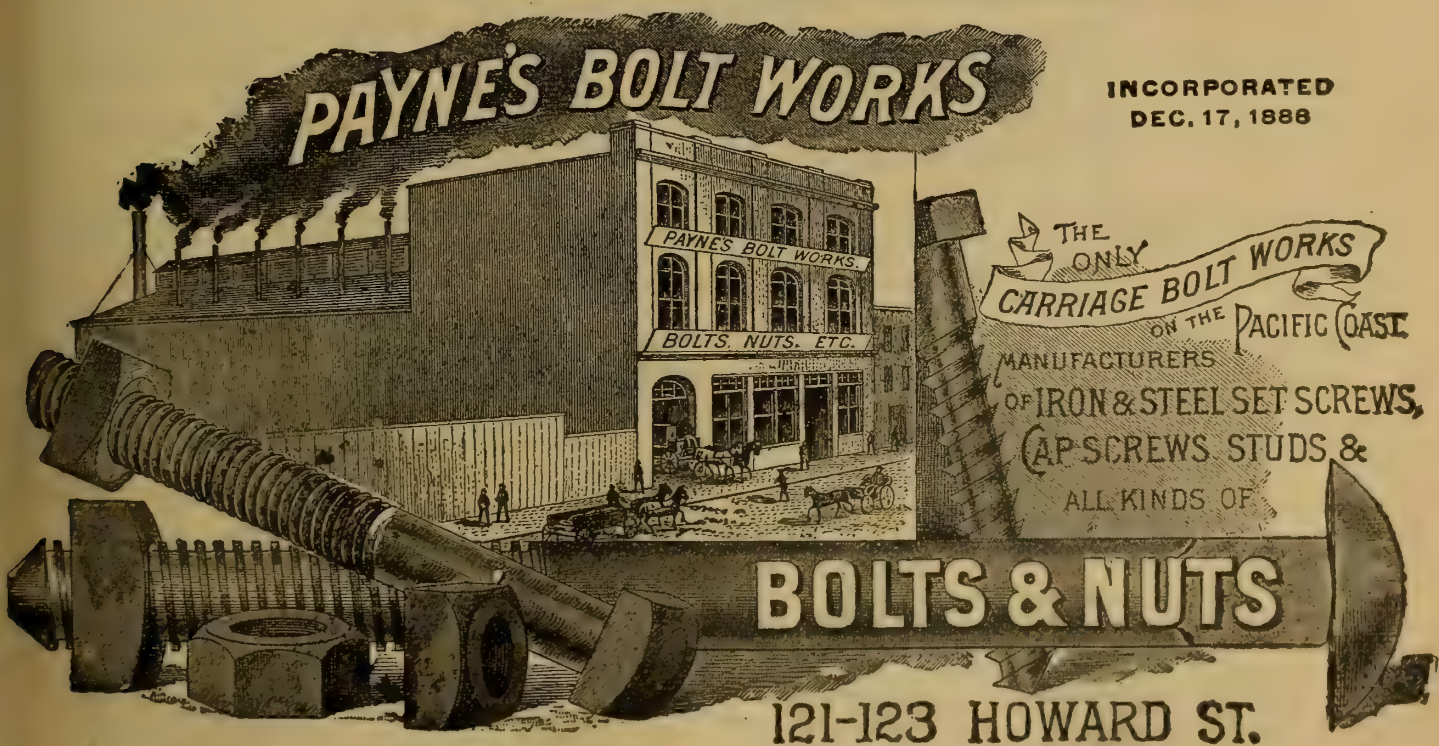
WIRE ROPE

For Mines, Logging Camps, Ships' Rigging, Street Railways, and All Purposes.

SAN FRANCISCO OFFICE:
8 and 10 Pine Street.

PACIFIC WORKS:
Bay and Powell Sts.

FRANK L. BROWN, Pacific Coast Agent.



Upset Bridge Rods, Truss Rods and Anchors, Turnbuckles, Head and Point Drift Bolts, Wine Cask Bolts with Brass Acorn Nuts, Cold Punched Square and Hexagon Nuts.

All Kinds of General and Special Blacksmithing

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. NOVEMBER 1895. No. 88

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

The Technical Society of the Pacific Coast is a grave body that deals with facts, figures and exact dimensions. There is not even the relief from seriousness and deliberation that characterized the Society on the Stanislaus, where a member was "caved in" by a lithic specimen thrown by an irate member of opposing opinion.

The importance of the Society, the only one of the kind on the Pacific Coast, and its rank among associations devoted to technical matters are facts not commonly understood by the world outside, and mainly because all matters that appeal to fancy or sympathy are stricken from the proceedings, even theory has only cool forbearance, and "pure science" lukewarm tolerance.

These circumstances having by some unusual process become obvious to the members, it was decided to drop for once sines, angles, coefficients, forces, engines, ships, electrics, hydraulics, pneumatics, and other of their subjects, and hold an "informal" meeting in October, at which there should be eating, drinking, a free expression of opinions and fancies, with complete irresponsibility.

This scheme took form on the 5th of last month, when a large number of members with invited guests dined at the *Maison Riche.* President Kellogg, of the State University, a number of the faculty from the Stanford University, Prof. George Davidson, and other guests, were present, and participated with much interest in the discussion that followed the dinner.

The President, George W. Dickie, Manager of the Union Iron Works, presided, and on being called up by Prof. Davidson, the Nestor of the profession on this Coast, spoke as follows:

"What I have to say tonight to the members and friends of the Technical Society, will partake somewhat of the character of this meeting; that is, it will be a departure from the usual type of address presented at meetings of the society.

"In fact, I desire you to accept what I have to say tonight as a kind of apology for the Technical Society. Its right to exist is a question of doubt to many good people who place the technical man among the lower orders of scientific associations. I objected to the name when the society began its struggle for life. It has often attempted to rise above the dead level of its surroundings, but its plebeian name is ever the weight that pulls it down among those who live to toil in the field of usefulness.

"The technical man is ever striving to make an application of the knowledge he has acquired to some grovelling workshop problem, and by so doing brings disparagement upon himself and the society.

"I would like to show you what a different estimation the world at large places upon purely scientific and practical technical knowledge.

"The world has decreed that the investigations into and the manifestations of natural phenomena should be divided into two classes, that of the scientific and the technical. A simple definition of these two classes would be, that those investigations that are of no immediate use are scientific, while those that have an immediate application to some industry, or that satisfies some want, are technical. I believe that all knowledge that lies within the power of man to acquire will some day be useful in supplying some want of his; but at present much scientific knowledge that has been acquired appears to have no connection with our physical advancement.

"Is it not curious that the world should honor those men most whose life work has no bearing whatever on man's physical requirements, or the extent of his resources, and has but little admiration for those whose lives have been spent in devising means whereby the burdens of humanity are lightened? The world places the philosopher in the top row of the scientific benches, while the mechanic is relegated to the lowest forms in the technical class. He who stumbles upon or discovers a new element in some of Nature's laws, stands infinitely higher in the eyes of the world than the

mechanic whose labor has produced work that has lightened the labors of millions of his fellow-men.

"I think this may be taken as a strong proof of the inherent intellectuality of men. Yet, when we consider the fact that the greater part of the world labors under the constant and unavoidable necessity of providing itself with daily bread, and never loses an opportunity to protest against the imposition, it would seem that one who seeks to relieve the burden of toil by the invention of labor-saving implements, would gain the gratitude of his fellow men. Yet, I do not know that the technical man deserves any better fate than has befallen him. His ambition is of the earth, earthy. He deals with 'things' instead of with 'ideas,' and therefore gets his reward from things, and not from men. His days are passed in close offices or dreary workshops. He has no delight in Nature, except so far as she will help him to turn his wheels. He concentrates his whole being within some little trade circle. From dawn to dark the technical man lives and moves, and has his being in iron, steel, wood, leather, or whatever other thing he makes or vends, and he often carries these things to his home, to make a technical shop of that sanctuary; tries to make a reputation by discussing them at the Technical Society with other technical people, and is sadly disappointed when the world takes no notice of him. And yet the world knows full well that there is but one possible source of relief for the burden of toil that afflicts humanity. This lies in the improvement and development of the industrial arts, the end and object of all technical effort.

"The better conditions of life that now exist, as compared with those of a century ago, are due almost entirely to the labors of technical men. Something has been done by the philosopher, something has been done by the statesman, and something has been done by the humanitarian. But what could all their efforts have accomplished without the mechanic?

"I have often been surprised that so few of the general public possess any knowledge of the men to whom the honor is due for the bettered conditions of life we enjoy.

"The ladies of society are considered wanting in culture who have no knowledge of those who by their writings add to the means of mental pleasures and accomplishments; but can one of them in a thousand tell to whom we owe the spinning Jenny or the power mule? Yet these inventions have made it possible for them to have the time for mental enjoyments.

"If the question be asked in a miscellaneous collection of educated men, 'who invented the locomotive?' it is almost certain that George Stephenson would be the name given, and doubt would be expressed if any one should explain that he only added a little to the labors of others in the same field. Yet amongst that same collection of men it would be considered a sign of want of education and culture not to be acquainted with the works of Kepler, Bacon, Newton, Davy, Faraday, Darwin and many others that have contributed to the sum of human knowledge, but whose work, at least at the time it was done, had but little promise of material help for humanity.

"The world is not entirely without gratitude, only the technical man is disappointed because he cannot buy its admiration by material benefits. A man may labor hard and wear his life out to feed and clothe his children comfortably, but if he forgets that they have hopes and fears, passions and emotions. when the earth closes over him, he will soon be forgotten. While the man that has a soft heart for their sorrows, and sings a song for their joys, lives long in loving memory, even though he was careless about their comfort, and though his song singing may have involved them in empty stomachs and bare backs.

"Where intellectual and moral emotions are possible, bodily comforts, difficult as they are to obtain for the majority of mankind, seem small by comparison, at least when they are actually enjoyed. Food and money appear the greatest possible blessings to the hungry and poor, but when once a good lining has been secured for the stomach and pocket, it is difficult to recall the cravings of the past, or exhibit the gratitude we expected to feel for those who made it possible for us to get into so comfortable a condition.

"Communities as a whole are very much like the individual in this respect. They soon forget those whose labors bestow upon them the power to do with little effort on their part what it took their fathers much time and toil to accomplish, while they reverence those who furnish them with some new mental pleasure. Who knows anything about Fairbairn, the millwright, and who does not know something about Shakespeare, the playwright?

"Outside of engineering circles James Watt is little more than a name with nothing about it to inspire admiration, and if he had not had the good fortune to be a Scotchman, and thus become the object of a clanish admiration, he would be as nearly forgotten now as the Welshman Trevithick. Yet every man, woman and child of this

and the last generation in the civilized world is the better for his inventions. Take a contemporary name of Watt's, that of Burns, and we find it known and admired wherever the English tongue is spoken, and far beyond that limit. He provided nothing new to help widen the scope of intellectual vision; the things he sang about were in the field and in the town, full in the sight of all, and only became bright from the charm and beauty of his setting. Yet, when touched by his inspiration they became a treasured possession of mankind, never to be abandoned or forgotten until human nature changes, of which there are no signs. The magnificent benefits that have resulted from Watt's inventions being material, do not touch the heart of mankind, and therein lies the difference.

"The difference between the scientific and the technical is, however, much smaller than that between the poet and the mechanic. The purpose of the man of science is to search out the meaning of that great universe of which he himself is a part, while the technical man labors to turn scientific knowledge to some useful purpose. They are but two links of the same chain, sometimes these links are far apart, and often they are found close together, but always of the same material.

"Faraday laboring to deduce the laws of electro-magnetic induction is very close to Wheatstone or Siemens laboring to produce a practical dynamo, only the one worked at the Royal Institution for the advancement of science, while the other labored in a workshop.

"The astronomer computing the orbit of a planet is doing the same work as the engineer computing the orbit of a centrifugal governor, only this difference, that the astronomer may make a mistake, but the planet rolls on as it ever has done. If the engineer blunders, his whole work may be rejected, and his work be thrown useless on his hands. How would a blundering astronomer feel if on account of his mistake in fixing the orbits of the planets the whole planetary system should be thrown on his hands?

"Regnault's researches into the properties of steam are not more important than the experiments of the engine builder, who embodies their results in a motor of surpassing economy. Lord Kelvin is not greater when he is investigating the physical condition of a wether than when he is quadruplexing an Atlantic cable. Nevertheless, the world has made up its mind that useful practical knowledge stands on a lower footing than that to which no suspicion of utility can attach. It will not consider if there be any difference in the intellectual power required to produce the result.

"The moment the world sees commercial bearing in any study it puts that and its author once and forever in a secondary position, and feels relieved of all obligation to or recognition of him. His discovery may have been the result of long and deep thought, and the research of a lifetime may have been expended in its development. But it is technical, and therefore has no claim on man's admiration. This is true, but on behalf of my technical brothers I claim that it is not right. Undoubtedly, mind is above matter or force, and life is more than meat. Yet there need not necessarily be anything debasing about that which makes meat more easily obtained for the bulk of hungry mankind. If the thing to be accomplished requires the application of the highest quality of mind for its solution, it is none the less intellectual because its accomplishment simplifies the struggle for daily bread.

"Let me say to our scientific and philosophical friends, who have honored us with their presence tonight, that we do not begrudge you all the honor and admiration the world can bestow, and we would not have you deprived of one ray of glory, while claiming that a little beam of recognition might occasionally lighten the gloom of the technical man's existence.

"The technical man himself is, in my opinion, to a large extent responsible for the slight regard in which he is held by the world at large. His work is not generally understood, and he is usually very proud and cares not what the world may think of him. He starts out with the idea that he can feed his soul on iron filings and sal ammoniac, and be satisfied. And when his nature has been all cemented into a sort of 'metallic' conglomeration he wonders why the world will not worship this iron image of a man.

"Our materialism and our utilitarianism is just what the world don't like about us. If we are ever to be anything else than hewers of wood and drawers of water to the people, we must touch them in more sensitive points than we have hitherto been hammering at. Let us put some mind as well as matter into our work. Let us clothe our technical things so that they will be received in good society.

"When the technical man can write a specification that the reading of will give mental pleasure to him or her who knows nothing about the thing specified, he will have his reward. Why can't he build up the various parts of the engine as he proceeds with the specification narrative, bringing crosshead and connecting rods, crank pin and journal, together, setting the various characters into

bold relief, each member of the group, working the reader up to the grand consummation when steam enters into the throbbing heart of the assembled parts, and the romance concludes with a wish on the part of the author and reader that nothing in the future life of the various characters thus assembled may cause them to part? We ignore what the world needs, and must have and expect that the world will honor us for so doing. The world will pay us just what it is worth for its food and clothing, that is, we will be allowed food and clothing like the rest, but if we want to be praised and admired for our work, that work must touch the great sensitive heart of humanity.''

President Dickie, who is given to original and consequently heretical opinions had evidently in view a purpose of stirring up a controversy by his remarks just quoted. He succeeded, and was happily replied to by President Kellogg, of the State University, Prof. Marx, of Stanford University, and others, who had no difficulty in showing the corelation between science and technology, and that an education, using that term in its broad sense, was not only essential, but a direct factor in the attainment of material results.

No one could dispute the President's remarks in respect to the position assigned to the ''useful man,'' or why Sir Walter Scott should have a monument, the wonder of Edinburg and of the world, while Adam Smith, who framed the commercial policy of his country, laid down the true laws of practical economics, should be planted under a flat stone overgrown with grass, and his name almost illegible thereon; or why James Watt could not find a corner in Westminster Abbey, because ''there was no precedent,'' and as Watt had never killed anyone, and had done only useful things, such honor to his memory could not be thought of.

Mr. W. G. Curtis, Vice-President of the Society, made some appropriate and interesting remarks upon the mission and possibilities of the Technical Society in relation to the interests and industries of this Coast, giving some statistics that were a surprise to most of the company. He pointed out that while the population of California is but two per cent. of the whole country, its production in certain commodities was as follows:

''Expressed in percentage of the whole amount for the United States, nearly 2 per cent. of the petroleum, 2.1 per cent. of the silver, 38 per cent. of the gold, 93 per cent. of the asphaltum, and all

of the quicksilver is produced in California. In agricultural products, there is grown in California 1.8 per cent. of the oats, 8.7 per cent. of the wheat, 17 per cent. of the hops, 22 per cent. of the barley, 23 per cent. of the beans, 60 per cent. of the wine, and 100 per cent. (or all) of the raisins produced in the United States. In valuation of products of manufactures, over 2.3 per cent. of the total value for the United States locates to California, the valuation per capita of manufactures produced annually in this State being $177, or 20 per cent. more than the value per capita for the remainder of the United States.''

On the whole the meeting was a success, and it is to be hoped a precedent for others of a like informal nature.

WORKS ADMINISTRATION.

BY J. RICHARDS.

A Lecture before the Students of the Leland Stanford Junior University, Palo Alto, California.

[Published by permission of the Faculty.]

When Professor Smith first mentioned the subject of lectures on ''Works Administration,'' or to use a more familiar term, shop management, the impression was that such a theme could not be treated so as to have interest separately from the regular studies you are pursuing here, but on more reflection it occurred to me, as it had undoubtedly done to Professor Smith, that while it was a part and parcel of technical education it was in the main separate and unteachable by the usual methods, and that something could be done in the way of relating observations and experience gathered in the practical conduct of works.

Your studies, such as this institution is to promote, must of necessity relate to particular methods and exact treatment, must come within the domain of computable quantities, and be governed by rules that are constant, or nearly so, while the management or administration of works must be empirically learned by observation, inference and analogy, not from one alone, but from many persons and in many places.

This being the case, so much as can be presented here in the form of lectures must be the result of experience and observation, and accepted as such. It is true that one may by logical inference

arrive at conclusions and methods of management, and it would be better if more was learned in this way, or that opinions were qualified in this manner, and in that view some attempt will be made to analyze certain things as we go along.

You have an advantage here not enjoyed so far as I know by the students of any similar institution in this country — that of an instructor who has himself been a work's manager, and is able to follow the problems here treated to their ultimate application. I may also mention this qualification as a succession, and perhaps to some extent an inspiration from one of the most successful teachers of constructive engineering that this or any other country can boast, Prof. John E. Sweet. "Sweet's boys," as they are called, always found something to do when they "went out into the world," as he termed it, and there is this encouragement in the scheme of lectures on shop management that the reputation of Sweet's boys grew out of his attempt, in a greater degree than ever before or since, to teach application and administrative matters. I say administration, because in most cases an education here, or in other institutions of the kind, is pursued with reference to directing and planning the work of other people, also as a stock in trade, so to speak, to be balanced against money, capital, and in other ways, but always involving management of some kind.

This art of management is unfortunately a subject that by its nature is personal, and for that reason concealed. A great share of it is confidential in respect to a works or a business. It includes to some extent methods and processes, that is, methods and processes personal to a manager, or peculiar to himself, invented we may call it, or regarded in the light of invention. This is proved by the fact that the power of management is in business in a sense considered separately from skill, or even technical knowledge, and, as every one knows, constitutes a valuable consideration in the hands of any one who has made a success in this way.

A successful foreman is an example of this. The ideal foreman is a mythical person, who is presumed to be able to do almost anything, and to be responsible for everything. He represents the owners, or the head management, and also to some extent the men whose work he directs; thus occupying a position of exceeding difficulty, inconsistent and nearly impossible on logical grounds and in fact. Of this matter of foremen more will be said in a future place. It is presented here in illustration of the difference between technical

knowledge and administration, and the value of the two when combined.

A pride in personal or peculiar methods is as wide as mechanic art, and is not to be disparaged, on the contrary is among the strongest incentives to develop the art of management, but such pride and confidence as you may readily infer becomes a bar to common knowledge of the manager's art. Owners, managers, superintendents and foremen are always ready to converse on general matters connected with their business, and of all that can be compared, estimated and written in books, but, as before remarked, there is a consciousness and intent of keeping back a good deal that has arisen out of particular experience, and this is not to be wondered at.

No one wants to state what they know there is no means of proving, and what has no grounds of conviction in their own minds. Empirical belief is always timid. A man may say, "I bore all holes with bars, do not use involute teeth for wheels, maintain standard sizes by means of turning mandrels, paint my machinery with lusterless paint, and do not indenture apprentices," but he does not regard these things as absolutely right, or expedient in all cases, because others whose practice he must respect do not do these things in his way, so there is a doubt and want of confidence that leads to reticence.

Pursuing these general or introductory remarks a little farther, the absence of fixed methods, rules and exact knowledge of management must always make it experimental. As in the case of a foreman, an ideal course or plan is impossible, because methods must be adapted to circumstances that exist in a works. The owners, head manager, workmen, and even the public around, have ideas of management and methods, and these ideas are apt to be like a good deal of other assumed knowledge of the kind, inversely as the amount of understanding in the case.

This is a peculiar trait of human nature. The person who has acquired barely the rudiments of any skilled operation is sure to imagine himself an adept. Bigoted people are almost sure to be unskilled, and this cannot be helped, so that one of the most difficult parts of shop administration is in understanding and carefully dealing with existing methods. I will relate a circumstance to illustrate this.

Some years ago I was called out to England partly to assist in preparing plans for some special machine tools required at the Els-

wick Works of Sir William Armstrong & Co., at New Castle on Tyne. On going to New Castle I found a great strike going on at the Elswick Works. More than a thousand men had quit work by reason of a disagreement in the forging department — a very important branch in these great works, which occupy in all one mile in length, on the bank of the River Tyne.

There was good opportunity to study this strike, which arose from a change of managers in the forging department, a Mr. O'Donnel, of Dublin, with whom I was well acquainted, having been recently installed in charge of the forges and connected operations.

Mr. O'Donnel had been in a high position before, as locomotive superintendent of the Great Southern and Western Railway, of Ireland. The railway works are situated at Inchicore, Dublin, and some explanation must be given for the reason of his being appointed at the Elswick Works.

Inchicore is a kind of normal training school for mechanical managers in Great Britain. From there comes a great many of the railway mechanical superintendents, because nowhere else has there been so much attention given to shop methods; besides, the men trained there are of high natural ability.

Inchicore is a kind of retired place out of Dublin some distance, where the pick of young men in the city find their way. There are wonderful coöperative and other provisions there that will come up to be more fully explained in a future section of these lectures.

In the forging shop there has been a development of "die forging" more elaborate perhaps than in any other works of the kind in the world. The dies, most of them, are merely matrices of cast iron or cast steel, two parts connected by a bar of spring steel bent into **U** form and attached to the two dies to hold them in "register," and permits the dies to open by the springing of this bow handle, to so call it. The blanks when heated are laid within these dies, which may be likened to waffle irons, and are placed beneath a powerful steam hammer that comes down and closes the dies by one blow, shaping the iron or steel just as any soft material, like putty, would be pressed into form. The surplus metal flows out in a fin, to be trimmed off around the edges.

Sir William Armstrong, or the directors of the Elswick company, were aware of the economic effect of this "spring die" forging system, as it was called, and employed Mr. O'Donnel to carry out this with various other improvements at the Armstrong works.

For a generation at least the "hammermen" at New Castle had

gone on in a routine of method supposed to be perfect, or at least traditional, which is sometimes construed as the same thing in those old countries, and no one dreamed that a change was expedient or possible.

The leading men made large wages, more than you will suppose possible in that country. They had inherited the business from their fathers, and were amazed at a proposition to introduce changes, consequently "went out," as they called it, with a large number of men in other connected departments, amounting to more than one thousand, and at one time nearly two thousand.

The strike was in a sense friendly, that is, conferences were held with the men, and Mr. O'Donnel found himself in a difficult and trying position. The directors of the works had their faith shaken by the views of the striking hammermen, but a ruse set the whole thing right.

On reaching New Castle I called at Mr. O'Donnel's office, and he explained the situation, at the end of his remarks pointing to a table near by, covered with a cloth, and said: "there is the argument that will sustain or defeat me."

He removed the cloth, showing a collection of small forgings of various standard patterns used in the works. On each was a ticket giving its weight, the price of forging at Elswick, and another unexplained figure alongside. These forgings had been made at Inchicore.

He had the table moved to the directors' room, where a meeting was held that day, and when he was called to be consulted he requested that the examples be examined. They were pronounced marvelous and perfect by every one, and on inquiry as to what this meant, Mr. O'Donnel said: "I am authorized to say, on behalf of the directors of the Great Southern and Western Railway of Ireland, that they will furnish and deliver here at your works as many of these forgings as you require, at the prices marked on the tickets."

This settled the matter there. The prices were only half as much in some cases, and much less in all than was being paid at the Elswick works. Mr. O'Donnel called the men together, told them just what he had done; explained the methods, also that his object was to cheapen production and not to reduce wages; that under the present methods, if persisted in, there would soon be neither work nor wages. The men went to work on the new methods, and a year later, as I have heard, presented Mr. O'Donnel with a friendly testimonial of their confidence and regard.

This dispute was much wider and more important than this single circumstance indicates. There were many other things to manage besides die forging, but by proper management all was in the end settled amicably and profitably.

The purpose of this story, related at some length, is to show that the new manager's knowledge of forging processes, or other technical knowledge of his, was not the main element in the case. He had to prove his position, gain confidence, both of the owners and the workmen, arouse emulation and establish good will, which was a great deal more difficult of accomplishment than the die processes.

As this first section of the proposed lectures will be of an introductory nature, dealing mainly with the nature and objects of the subject to be treated, it will be proper to say something further of the importance of administration and its relation to active industry.

On this Coast has been founded or projected at some time almost every industry known to the technical arts. Some of these attempts logical, some otherwise, and of all only a few have succeeded well. This remark is true of most any other place, but not in the same degree or under the same circumstances as on this Coast. People come here from the Eastern States and from all parts of the world, attracted by the promise and opportunities that are supposed to exist in a new country, but mainly because of the climate and physical peculiarities of the coast that have rendered it famous. At first they came to mine gold, or to participate in the circumstances which gold mining produced. These people brought with them knowledge and experience in nearly every art known to human skill, and when here, and the period of speculation passed away, they naturally looked about for permanent pursuits.

A great many come now for their health, or to avoid the rigor of winters at the East. They cannot remain idle, and naturally set about the business with which they were acquainted in their former homes. This, as before remarked, has led to the founding at various periods, of nearly every kind of skilled industry, from making watches and jewelry to steamships, and from silk fabric to gunny bags.

Some of these industries have succeeded, more of them have failed, and when the cause of the failure is inquired into, a long train of causes is set up, some of them reasonable and sufficient, but in most cases neither. Among these reasons of failure, which need not be enumerated, one rarely ever hears of management or admin-

istration, still among all causes of failure this is undoubtedly the most common one, either alone or associated with others of less import.

Some years ago I asked Mr. Calvin Brown, the well-known civil engineer of San Francisco, why the 300,000 barrels of hydraulic cement used on this Coast were not made here, and if the natural elements did not exist? His answer was that the required elements did exist here, except one, which was management of the manufacture; that the material and processes of production permitted a reasonable profit, but there was no regularity in the cement produced, and a want of confidence in its uniformity. Mr. Brown was the first engineer on this Coast to erect concrete work, when he was in the employ of the General Government, and was also, as I believe, the superintending engineer who constructed some of the cement works founded near Santa Cruz, in this State. He is a recognized authority on this subject, and his calculations were, no doubt, made to include all the economical conditions involved in the manufacture.

Not satisfied with this explanation I submitted the matter to Prof. Louis Falkenau, an analytical chemist of San Francisco, a man able in his profession, and thoroughly acquainted by both education and experience with the resources of the Coast, all of its minerals and the economy of manufactures. His views corresponded with those of Mr. Brown, and he also claimed that the failure of this important industry was due to a want of a technical and commercial management of the works founded.

Now assuming these views of the matter to be correct, and even that the impediment is now removed, the misfortune of the matter comes up in another form. Capital is frightened off, and no one with this history before them will engage in the manufacture of hydraulic cement.

The force of this illustration would be greatly increased by adding various facts that have been related to me in connection with cement manufacture on this Coast, but as no new ventures of the kind have been made in the fifteen years I have been here, these facts are not reliable enough for recountal at this time. Every one, so far as I know, admits that good cement was made, but as one man expressed it, "no barrel had two ends alike," meaning that there was no uniformity in the process, and no exercise of the intelligent painstaking care required in what is an intricate process, demanding not only complete chemical and technological knowledge of the art, but an intense application of these, and the handling of men unused to any work requiring precision.

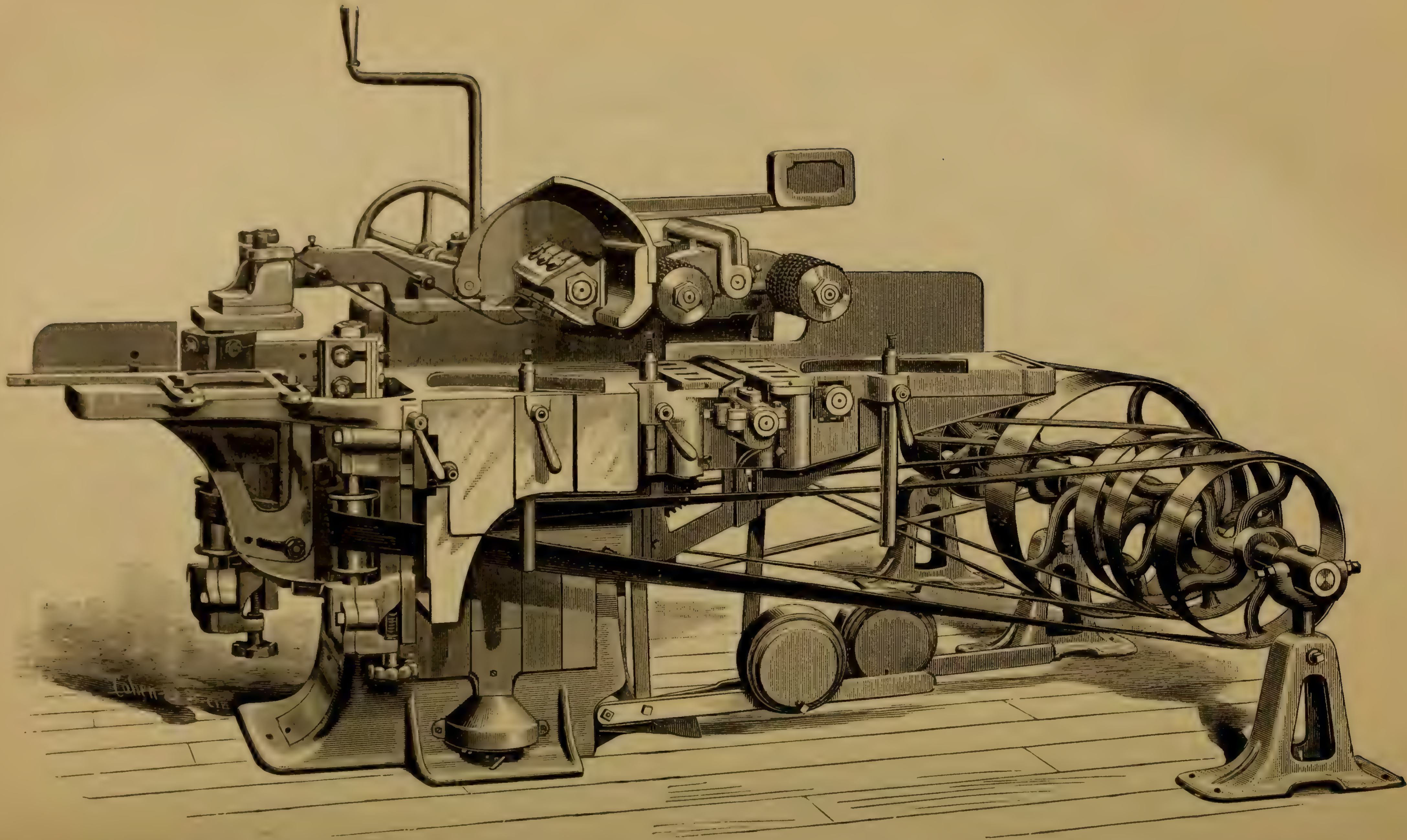
Any one desiring to investigate this matter further will find some account of it in a paper on the subject by Mr. Calvin Brown, read before the Technical Society of the Pacific Coast about five years ago, and published in the Transactions of that Society. Some time, let us hope soon, this manufacture will be founded again, and prosecuted to a successful issue.

I happened to be in Sweden when this same manufacture was founded there, and many times have thought of the difference in methods. It is not to draw invidious comparisons, but is relevant to the subject under discussion. Sweden had been importing a good deal of Portland cement, and when the subject of local manufacture came up the best-informed chemists in the country examined the natural material existing there. Experiment and careful calculations were made respecting fuel, transportation, labor, and everything of an economic nature was considered by merchants and engineers. A cement works was erected near Gothenberg, and the King of Sweden, Oscar II, came down to attend the opening of the cement works.

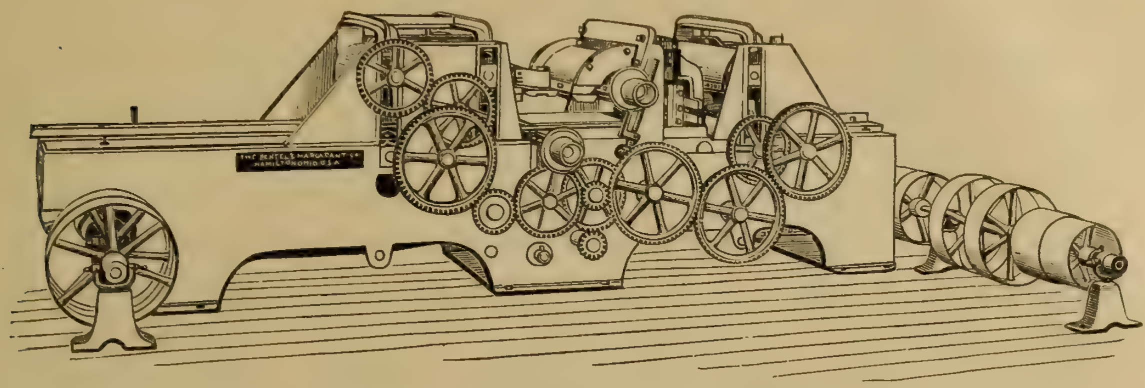
This monarch, unlike most others, thought it worth his while to learn industrial as well as military science, and enjoys, as I believe, the distinction of being the most learned man that occupies a throne at this day. He mounted an improvised platform in the works at Gothenberg, to address the people, and in addition to reviewing the commercial importance of the scheme, gave a history of the manufacture, describing the whole technical detail of elements, processes and uses. Capable and careful men were put in charge, and I have no doubt the industry is going on now in a prosperous manner. From the inception of the scheme there was complete administration, and unless there were errors in the original computations there was no chance of failure. The circumstances related happened nearly twenty years ago.

In the older countries, where trained skill is more highly estimated, and where consulting engineers are more commonly called in, and, I may add, where all the conditions of manufacture and construction are more cautiously considered, the failure of enterprises is rare and also is serious. We have many lessons to learn from their longer experience, especially as our future must in many respects lie along the same road.

(To be continued.)



 Four-Side Planing and Moulding Machine.—The Bentel & Margedant Co., Hamilton, Ohio.



WOOD-PLANING MACHINES.

THE BENTEL & MARGEDANT CO., HAMILTON, OHIO.

It will be remembered that "INDUSTRY" began about seven years ago a "crusade" against the method in which planing and moulding machines were arranged in this country. The subject was taken up from time to time, showing the faults and inconsistency of reversing the hand method of planing when the same work is done by machines, also showing that in no other country in the world was planing done in the same manner, that is, to thickness and form a face at the same time on "top" of the timber, and then gauge profile work, tonguing, grooving, or other operations from the "back" and finally when all other operations were done plane the bottom, which is the true face, that should be planed first.

The objections are that the timber slides on the rough side, and unless flexible enough to bend, the line of the top or profile is a reproduction of the bottom or rough side, and if a piece is too thin, the unplaned side, as in flooring or ceiling, comes on the upper or face side, and the piece is lost, also if the thickness varies by the top knives wearing or by adjustment the "match" is destroyed, because the side work is gauged from the bottom of flooring or the inside of ceiling.

There are other faults or imperfections in the system that have prevented the sale of American machines in other countries where there has been a large foreign trade in wood-working machines of other kinds. To ascertain how far this matter had engaged attention we applied to one of the most able and progressive firms in this country, the Bentel & Margedant Company, at Hamilton, Ohio, and are astonished to find that all their machines for planing more than one side at a time are arranged to plane a face on the bottom first, and then follow with the other sides.

We have not space this month to give illustrations of their practice beyond a moulding machine, shown on the page opposite, and a

diagram at the head of this article illustrating the arrangement of their planing and matching machines, in both of which, as may be seen, the bottom cutters are in advance. The following extract from one of the company's circulars gives their view of the matter:

"A chief advantage, and one of great importance, is placing the fourth or lower cutterhead at the front of the bed instead of in the rear, which is still the faulty primitive construction pursued by other makers.

"The old established rule of planing the lower side of material first, in hand planing, to insure a smooth surface, from which base the size and shape and depth of cut can be laid off accurately, holds good as well in a machine planing on two or more sides as done on a moulding machine.

"It is also of importance to plane that surface on which the material slides on the accurately planed table, free from any grit or loose splinters, as thus a solid firm bearing free from rocking motion is secured, and the friction resulting from the pressure of the necessary pressure plates and hold-down springs is reduced to a minimum.

"The material is received by the first feed roll, and passed over the lower head, affording the smooth and accurate lower surface before the other three cutterheads are reached. The advantages of thus establishing a free and easy forward movement of the material on its now smooth sliding surface, and of an accurate base line from which measurements can be taken, not changed by the subsequent planing of other heads, will be appreciated."

We may also mention other improvements and designs, such as are suggested by this intelligent view of planing, some of which will be illustrated in future numbers of "INDUSTRY."

Continued from page 616.

THE MODERN GAS ENGINE.*

BY G. E. STEVENSON.

IGNITION AND GOVERNING.

"Improvements in valve and governing gear have played an important part in the development of the modern gas engine. The substitution of independent lift valves for the old slide has already been referred to. This enabled makers to work the gas and air

*Paper read before the Incorporated Institution of Gas Engineers, London.

admission separately, and so better to regulate the proportions of gas forming the explosive mixture. In the modern engine the air is admitted at every cycle without alteration, and only the gas supply is interrupted by the governor. The governing of the Otto engine has always been effected by Messrs. Crossley Brothers, on the hit-and-miss principle. In the engines the governor, which was of the centrifugal type, determined whether or not the gas-valve lever should be struck by the cam on the side shaft. Two types of governors are used in the later engines, a centrifugal for the larger and an inertia governor for the smaller sizes. In the largest engines a lever carrying a roller and a steel blade is actuated by a cam at every revolution of the side shaft, and a disc is moved by the governor in a vertical direction into such a position that when struck by the blade it opens the gas valve. When, by increased speed, the governor rises, the position of the disc is so altered that it is not struck by the blade, and the valve remains closed.

"A modification of this plan is adopted with engines of a moderate power. The governor moves in a horizontal direction, a disc, set loose on a spindle, which is attached to a bell-crank lever actuating the gas valve, and according to the position into which the disc is moved by the governor, it is struck, or not, by a narrow step on the cam of the side shaft. The inertia governor applied to small engines consists of a small weight and blade, pivoted on a bell-crank lever, which tends to lag behind as the engine increases in speed, and hits or misses the valve spindle. Means are adopted in addition, whereby the discharge valve can be opened at every in-stroke of the piston, so as to do away with compression at starting. The cam actuating the discharge is made to slide on the shaft, and at one side has a narrow projection or step forming a secondary cam opposite the primary one. When, by moving a lever, the cam is shifted to the starting position, the secondary cam acts on the discharge as well as the primary one.

"The governing of the engines made by Messrs. Tangyes, Limited, is done by the movement of a roller along a pin on the gas-valve lever, which brings it opposite a grooved cam on the side shaft of the engine. In order to prevent snipping of the gas-valve (*i. e.*, partial contact between the cam and the roller, and subsequent slipping off of the latter), a second (knife-edged) cam is used, which, coming in contact with a knife-edged collar on the roller, fixes its position when opening the gas valve, exactly opposite the cam.

"The abandonment of the slide necessitated an alteration in the method of ignition. Messrs. Crossley Brothers introduced the system of tube igniters. These were first made of wrought iron, closed at the upper end, and placed vertically in a cylindrical casing. The lower end communicates with the cylinder, and the tube is kept red hot by the flame of a Bunsen burner. These tubes have a short life, and become corroded, so that the heat of the flame is unable to penetrate the metal and keep it sufficiently hot to ignite the charge. Messrs. Crossley experimented with tubes of cast iron, nickel and platinum alloys, and other mixtures, but have finally adopted porcelain tubes, which, while possessing the advantages of being quickly heated and of costing little for renewal, are practically indestructible by heat. They are now generally placed horizontally in a rectangular casing, one end of the tubes fitting over a nozzle communicating with the cylinder, and the other closed by a pin held tight by a screw or spring.

"An important feature in the modern igniting arrangements is the timing valve. This valve opens communication with the cylinder at the moment when ignition is required, and allows a small portion of the charge to be injected into the tube, where it fires back and explodes the charge. Some makers dispense with the timing of the valve, and make it open automatically by the pressure of the charge. Under these conditions, however, it is difficult to prevent premature ignitions, which may cause a very severe strain to be thrown upon the crank shaft and cylinder of the engine. The French makers of gas engines mostly adhere to ignition by the electric spark, which was the method adopted in the Lenoir engine.

STARTING GEAR.

"The development of the gas engine is in nothing more marked than in the increase of their size and power; many single-cylinder engines are now being made in this country of 100 horse power effective. Messrs. Tangyes, Limited, have just completed one large single-cylinder engine, indicating 180 horse power with Dowson gas. They have also lately made one with a cylinder 24 in. diameter, and a stroke of 30 in., to run at 150 revolutions per minute, with a piston speed of 750 ft. per minute. The trials of this engine with producer gas have given an indicated horse power of 196, and with Welsh anthracite coal a fuel consumption not exceeding 0.8 lb. per indicated horse power can be guaranteed. The exhaust valve would require to be of such large area, and as it would have

to lift against a terminal pressure of 40 lb. per square inch, that the strain upon the pins, levers, and cams would be very great, it was considered advisable to use two valves instead of one, the areas of which are in the proportion of 2 to 1. Both valves are actuated by the same lever, but the smaller one is raised first, and held up for a little time to reduce the pressure before the large valve rises.

"Another engine has lately been constructed by Messrs. Dick, Kerr, and Co., of Kilmarnock, of 270 indicated horse power (with Dowson gas); but this is a double-acting engine. On the Continent the firm of Matter, in Rouen, has constructed a single simplex engine of 300 horse power, devised by Messrs. Delamare, Deboutt-ville, and Malaudin, which does not differ in principle or design from the Otto type.

"In large engines the opening of the heavy gas valves used with producer gas causes excessive wear on the narrow-edged cams. To obviate this Messrs. Tangyes have adopted in their latest engines a method by which the gas valve lever actuated by the cam does not act direct on the valve spindle, but does so through a tumbler which is kept out of a gear by a spring or weight. One end of a light secondary lever is connected to the tumbler, and the other end is provided with a roller sliding on a pin, and moved by the governor, as in the ordinary sized engines. This roller is actuated by the usual grooved cam, and the main gas-valve lever by a broad cam at every revolution of the side shaft, in the same way as the air-valve lever. The secondary lever brings the tumbler into position, so that the main lever can raise the valve.

"The demand for large engines has rendered necessary the application of self-starting gear. Engines up to twelve horse power nominal can be easily started by hand, but above this power starting appliances are desirable, and in large engines are absolutely essential. There are several ingenious methods adopted, all of them having for their object the introduction of an explosive mixture into the cylinder (either with or without compression), and by the firing of this charge to start the engine. Messrs. Crossley use a hand pump to charge a receiver, and when communication is opened between this and the cylinder, the mixture enters and replaces the air previously contained therein. A few strokes of the pump raise the pressure to about 1 lb. above the atmosphere, and the mixture is then fired at the receiver and the combustion propagated in the cylinder. Messrs. Andrews, of Stockport, employ a different method.

In their engines gas is introduced into the cylinder through a small valve kept open by a spring. The gas displaces part of the air, and in due course forms, with the remainder, an explosive mixture, driving out the air before it, which, on passing through the incandescent tube, fires back and starts the engine. The pressure of the explosion automatically closes and locks the spring valves by which the gas is admitted and the air etc., discharged. In Messrs. Tangyes' engines, Pinckney's self-starter is used. By this method an explosive mixture is introduced under pressure into the cylinder, the crank being prevented from revolving by a spring, which releases it when ignition occurs, the degree of compression being regulated by a safety valve on the pump. In starting large engines, or when it is required to start several engines at once, Messrs. Tangyes now use a mild steel reservoir, into which the explosive charge is pumped to a pressure of 80 lb., and from which the cylinders are charged. Messrs. Fielding and Platt use a small reservoir, which is charged with compressed air only. In starting, a charge of gas is introduced into the cylinder, and the air from the reservoir is mixed with it, thus forming a compressed mixture. The charge is fired at the igniting tube after the piston has commenced to move under the influence of the compression. Messrs. Dick, Kerr, and Co. have departed from the plan followed by most makers in their large engine, which is started by steam from the small boiler used for making Dowson gas."

(To be Continued.)

COMPRESSED AIR FOR STREET RAILWAYS.

We have been courteously furnished by the Western Compressed Air and Traction Company, of Chicago, with advance matter from a prospectus about to be issued relating to the use of air as a motive power for street railway propulsion. Most of readers will be aware from notices in "INDUSTRY, and from other sources, of the spread of the compressed air system for street railways in France, such lines now being in operation at Paris (3), Nantes, Nogent, Marseilles and in Berne, Switzerland. An American company, called the General Compressed Air Company, has been chartered in New Jersey, and a western branch under the title above at Chicago.

The economy and general working conditions of the compressed air system are such as to demand its serious consideration in this

country, especially as it seems to be almost wholly free from the objections that apply to horses, steam, gas and electricity, objections that are inherent, and from a public point of view are formidable.

In the prospectus before named will be published a communication from Dr. Chartard, of Paris, to the Society of Civil Engineers of that city on the Mekarski system of compressed air propulsion in the streets of Paris. The following are some extracts:

"The Compagnie Generale des Omnibus de Paris is just now getting through with the equipment of three of the most important lines of its system with the compressed air traction (System L Mekarski). The three lines to be equipped are: 1st., from Louvre to St. Cloud, length 6.5 miles; 2nd., from Louvre to Sevres and Versailles, length 11.8 miles; 3rd., from Cours de Vincennes to St. Augustin, length 5.68 miles. The first of these three lines will be operated by trains starting every fifteen minutes, the second every half hour, the third every seven and one half minutes.

"1st. The lines from Louvre to St. Cloud, and to Sevres and Versailles. These two lines will be operated by means of locomotives, pulling a train composed of three trailers with covered seats on top (seating capacity of each, 51) between Louvre and the gate of Point du Jour; at this place the train will be divided, one trailer will be pulled to St. Cloud, and two on to Sevres and Versailles, one of these going no farther than Sevres. * *

"The locomotives, designed especially for these lines, have three-truck couples together, they weigh 18 tons in working order, say 6 tons on each track. They will thus have the necessary adhesion to run over 4.3 per cent. graded at Sevres in drawing two, and even three trailers, the load of each trailer with its load of passengers being eight tons. The locomotives are also provided with sand boxes in cases of emergency in damp weather.

"The service, as described above, of these two lines will give daily 1,158 car miles. To do this there will be fifteen locomotives always on the road, and two in charging, in all seventeen. The company ordered twenty locomotives, to have three in reserve, one at Boulogne, one at Point du Jour and one at Sevres. These locomotives, of which it is not necessary to give here a detailed description, have been built on the design of Mr. Mekarski, by the Societe des Anciens Etablissements Cail. They are constructed so they can be charged to 1,137 pounds to the square inch (80 kilogr. per square centimeter). The daily mileage will be 2,200 car miles, corresponding to the mileage of the 35 horse cars. * * * * *

"2nd. Line from Cours de Vincennes to St. Augustin. This line will be equipped with motor cars, with covered seats on top, their seating capacity will be for 51 passengers. If necessary they will draw a trailer of 51 seating capacity like those on the lines equipped with locomotives. Accounting but a small part of the mileage, the trailers drawn by the motor cars, we can say that the mechanical traction will take the place on this line of 400 to 500 horses. The company will have eighteen motor cars in use on the road, at the same time two at charging stations and two in reserve." * *

Experiments have for some time been going on at Rome, New York, under the direction of Mr. Robert Hardie, who has given the subject wide attention in respect to its adoption in this country. Air is used under a pressure of 2,000 pounds per inch, reduced in working to 150 pounds per inch. A report on these experiments has been prepared by Mr. Edward E. Pettee, C. E., from which we have space for only a few notes.

The time required to charge a car, including connecting, is only 30 seconds. The volume of air stored is 35 feet for each car, sufficient for a run of 15 miles. With the air-storing tanks is one containing six cubic feet of superheated water at a temperature of 325 degrees. The air from the receivers at 2,000 pounds per inch is reduced to 150 pounds per inch, then passed through the hot water and thence to the engines, which are 6 inches bore, 14 inches stroke. The motors are free from heat, noise, odor or other objectionable features.

Mr. Pettee, who is one of the most prominent railway engineers in this country, having been connected with the Sprague Electric Company, then Manager-in-Chief of the railway branch of the Edison and Thomson-Houston Companies, and recently installed the celebrated plant of the Baltimore and Ohio Railway Company across the city of Baltimore, and has held other high positions of like nature. The following is a brief quotation from his report on the compressed air system:

"Extended and critical examinations of the subject show compressed air to possess remarkable economic features as a motive power when used with reheating devices. The heat, according to the experiments of Riedler and Gutermuth, is used five or six times as effectively as heat supplied by a good steam engine.

"In tests made by me at Rome, N. Y., I found the heat taken by the air in passing through the hot water increased the average

efficiency of the motors from 95 to 100 per cent. during an hour's run, stops being made every 800 feet.

"The task of storage of compressed air presents no mechanical or physical difficulty, nor does it involve any prohibitory expenditure, even in providing sufficient capacity to enable the power station to run 24 hours, storing air when there is no service, or where the service is lightest. This would enable the power station to operate fully 20 per cent. cheaper than on an 18-hour basis, besides providing a way for owl cars at no other cost for power than that of the day cars, and all day cars would be charged at night."

DOWN DRAUGHT STEAM FURNACES.

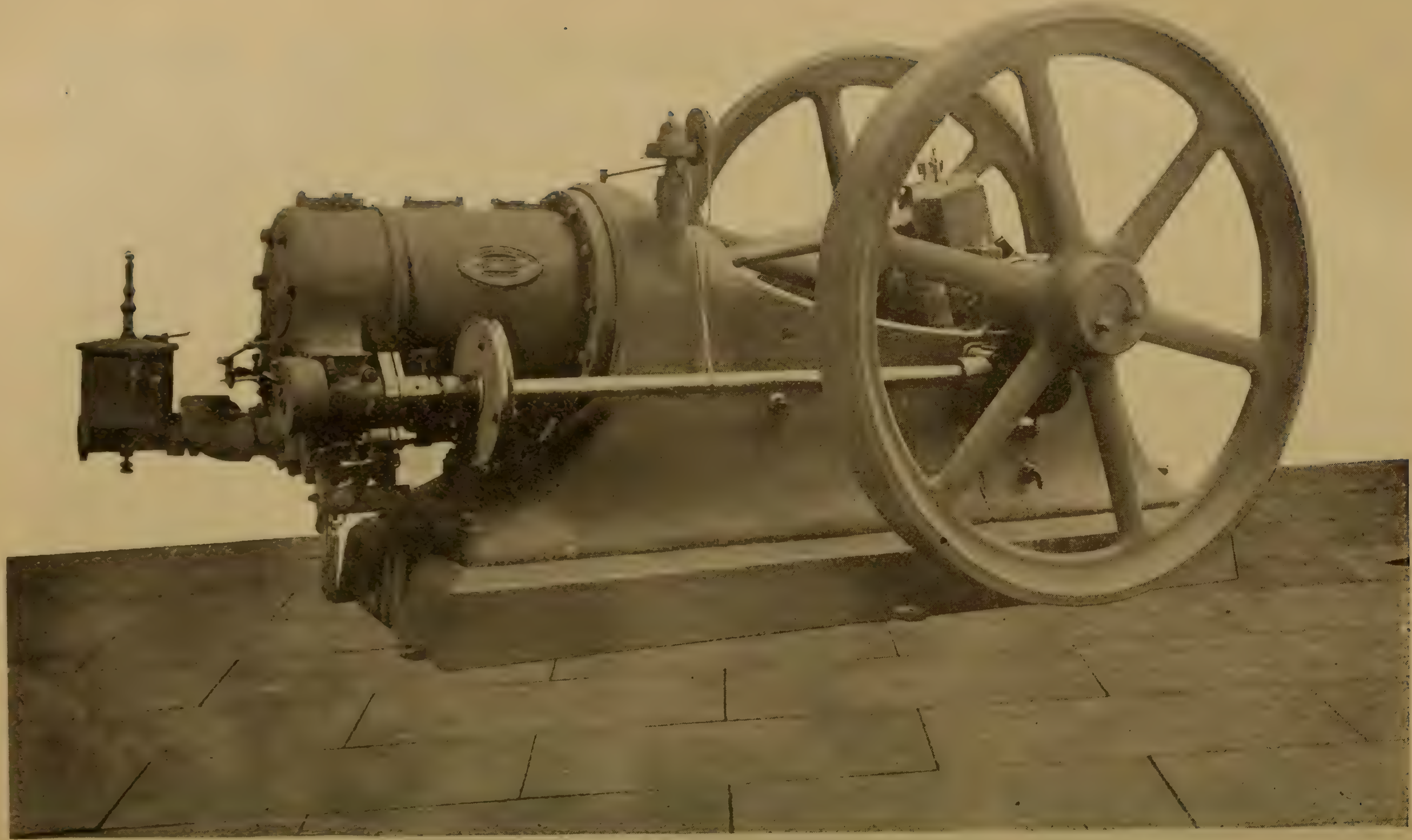
There is something strange in the fact that the Hawley furnaces have been so extensively adopted in the Eastern States, and do not make corresponding progress on this Coast, unless it be because there are no restrictions on the smoke nuisance.

We have for eight years past advocated and argued the importance of some system whereby the fresh fuel was not fed on top of the fire, and the gases of combustion passed through it. It is a method wrong in conception and results, wasteful, and a nuisance, but there has been the difficulty of maintaining fire bars exposed to the intense heat of the fire that passes through them.

This was, and is, so far as we can see a sole objection to the Hawley system, wherein the draught is downward through the grates, but as first remarked this difficulty seems to be a geographical one, because in Chicago, St. Louis and elsewhere in the East hundreds of furnaces on this method go on performing their work to the satisfaction of the owners and every one else.

Messrs. Tracy, Starkweather and Tracy, of this City, the agents here of the Hawley down draught system, sent in some time ago a list of such plants at work. It is mislaid at this time, but the number and extent were a matter of astonishment.

That some change in the methods of combustion must soon come about all engineers are ready to admit. The refinement of engines and boilers seems in a measure useless, so long as half of the heat units contained in the fuel are lost by imperfect combustion, and of all the various improvements none seem so direct and rational as to lead the gases of combustion down, or away from, instead of through the fresh fuel added.



50 Horse Power Gas Engine.—The Union Gas Engine Co., San Francisco.

50 HORSE POWER GAS ENGINE.

THE UNION GAS ENGINE CO., SAN FRANCISCO.

The plate opposite is made from a photograph taken from a third engine of 50 horse power, made by the Union Gas Engine Co., for a mining company in Arizona.

This company adopted gas engines tentatively, ordering one at a time, for pumping, hoisting, and to drive their mills, waiting in the two first cases to arrive by experiment at the results as to economy, efficiency and endurance, so it may be said there is no experiment in respect to all these points, which comprise all that need be considered. In arid, untimbered regions, remote from railway connection, which are the circumstances common to miners in the southern portions of this State, Arizona, and New Mexico, there is no doubt a great economy in the use of gas engines, not only as to fuel, convenience and running expenses, but in deterioration and maintenance, not that these circumstances limit the use of such engines, but sooner bring the system into use.

As to a comparison with steam power we have not inquired, but the Union Gas Engine Company have no doubt such estimates and particulars in the present and other cases, that can be ascertained on inquiry. The engine shown, and the others that preceded it, we have examined during construction and when completed, and must admit that the general design, finish, material and workmanship reflects much credit on the company, and to this important branch of our local industries.

When last at the works we came upon what the French call a "horseless carriage," constructed to order for some one with a judicious and logical dread of animated apparatus for propulsion. We have full sympathy with the views of the owner, and think the gas engine will not only be more easily controlled, but infinitely safer as a means of locomotion. The engine, carriage, or whatever it is, seems practicable and well made, but as we cannot help recognizing, it is one of those disagreeable jobs that upsets the routine of a works, and as a "manufacture" always gets on the wrong side of the ledger.

Mr. Çasey, of the Philadelphia works, who has recently been here, reports continued success in that branch of the business, and the San Francisco works are fully occupied, mostly on marine and other engines of the larger class.

CANAIGRE.

This plant, now coming into prominence as an agricultural product in New Mexico, Arizona, and possibly over the whole range of the Pacific Coast, is employed in tanning leather. It has a bulbous root, resembling the sweet potato plant, that when dried contains 25 to 30 per cent. of tannic acid or "tannin," the active element in chestnut, oak, hemlock, gamboge, wattle and other substances now employed in tanning leather.

Canaigre (*Rumex Hymenosepalus*) freely translated is *cane-aigre* (sour cane), and is simply the well-known "sour dock" that furnishes "greens" throughout a large portion of the United States, at least this is the inference we gather from bulletins furnished by the University of Arizona, where the plant has been the subject of careful but not yet completed analysis.

It seems that about five years ago a company was organized here in San Francisco to procure and export wild canaigre to European countries where its tanning properties are known, but the supply was not enough and the scheme was abandoned, cultivation not being intended or attempted by the company.

A company in Arizona engaged in the business of exporting the plant, and Mr. E. C. Denig, of Deming, New Mexico, has sent out a large quantity to various tanneries, especially abroad, but in some cases in this country. The Tanning School, at Freiburg, Germany, where careful experiments were made, has done the most to determine the commercial value of canaigre.

The trade has now become an important one. 370 carloads were sent out over the Southern Pacific Railway in 1891, and it is thought as much more by other lines passing through Arizona and New Mexico, or 740 carloads in all, and the amount has, no doubt, increased since then, all being sent to Europe along with the hides to be tanned, which is not unlike some other things on this Coast.

The source now is wild "patches," where the roots are dug by contract, and sliced by machines, dried and packed for shipment. The natural supply will soon be exhausted, if not so now, and from information contained in the bulletin above referred to we are of the opinion that the alluvial lands in the great valley of California will grow canaigre, especially the reclaimed districts where the moisture is at control.

The present value is about $50 a ton, and as tannin has a price

as constant as any other commodity, not excepting even silver, there is a good deal of permanence in its cultivation, besides it would replace about 15,000 tons of "gambier" now imported into this country at a cost of one and a half millions annually.

CALIFORNIA DEEP-WELL PUMPS.

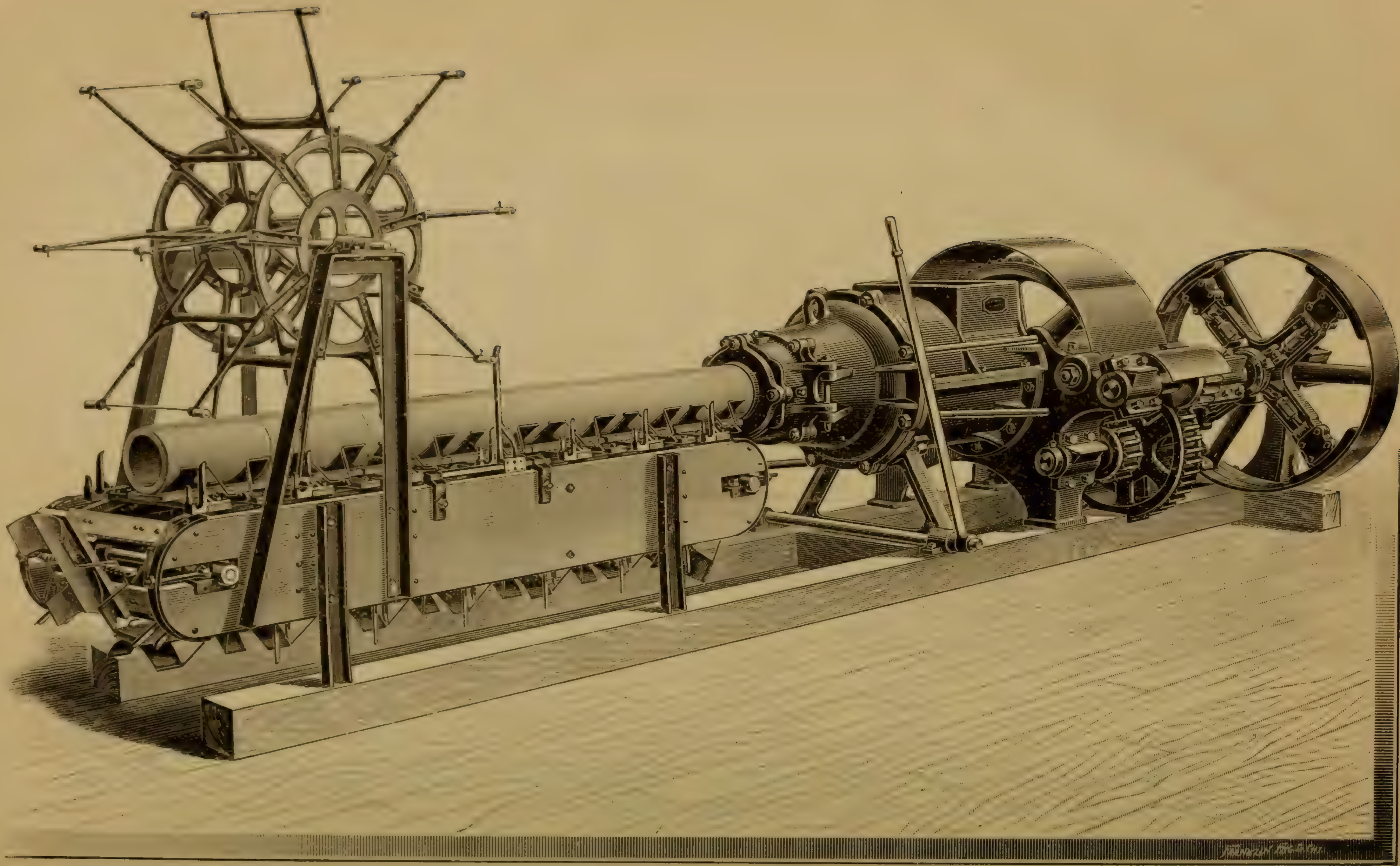
There is one branch of manufacture here on this Coast carried out in a manner that leaves but little competition, that of deep-well pumps, extensively employed all over the Coast for water supply from wells.

The Eastern modifications of these pumps are but an imitation of the hand type, about one half the weight of the same sizes made here, and requiring ten times the attention in use. The methods followed are to secure endurance, because such pumps when put down to be operated by an engine or wind wheel a record is kept of endurance as well as duty, and when a pump is placed from 50 to 150 feet below the surface, endurance is the main quality to be considered.

Of this a single case will serve to show what has been attained. In 1880 Messrs. C. H. Evans & Co., of this City, then Thompson & Evans, erected in the Sherwood Building, corner of Market and Pine Streets, in this City, a deep-well pump to supply the building for elevators and other purposes at the rate of 4,000 gallons an hour, the pump being placed 80 feet below the surface. This pump has never been drawn or seen since that time, and no repairs made below the surface for a period of more than 15 years, the pump performing daily a regular duty of 20,000 to 40,000 gallons raised about 150 feet to tanks on the roof.

How the wearing surfaces in a pump can last for this length of time is hard to conceive. There is evidently no grit, the metal very hard and perfect alignment. It is the expectation on this Coast in putting down a deep-well pump that nothing more is to be done for some years to come, and this is commonly the case.

We have had at various times data to confirm these claims made for California pumps, but in no case a longer "run" than the one noted. Some time ago we examined at Napa, Cal., a deep-well pumping plant that had been in use for about eight years. The steam boiler and engine were, as the owner said, "about used up," but the pump he knew nothing about, not having seen it since it was put down.



AUTOMATIC TILE-MAKING MACHINERY.—THE FREY-SHECKLER CO., BUCYRUS, OHIO.

AUTOMATIC TILE-MAKING MACHINES.

THE FREY–SHECKLER CO., BUCYRUS, OHIO.

To ascertain American practice in clay-working machinery we addressed a letter to the company above named, and have received from them a circular that is a matter of astonishment.

Of course every one knows to what extent clay products enter into the necessary manufactures of a civilized country. Brick alone constitutes an element of such vast extent that it is not easy to comprehend the amount, and when to this is added draining tiles or pipes, sewer pipes and structural work made of clay, the total becomes an amazing volume. One need not wonder therefore that the machines required have become a special branch that includes a wide range of designs, calling for a catalogue of 140 pages, 7 × 10 inches, to describe them.

One of the machines chosen for illustration this month is shown on the opposite page, a tile-making machine, capable of preparing from 10,000 to 15,000 pieces of tile pipe in a day. The machine consists essentially of a cylindrical vessel of great strength, containing a screw driven by powerful gearing, seen at the rear. This screw pushes the material forward, forcing it out through a die at the front, where the continuous pipe of soft clay passes on to a revolving chain apron or carriage, composed of sections corresponding to the lengths or sections of the pipes. The reel mounted over the top is provided with thin wires, stretched tight, that pass down through the soft pipe, severing it into pieces that are afterward dried, and then burned in a kiln. For brick a similar machine is employed, but with rectangular dies and no core, the bar or stream of clay being solid. Drawings of a machine for making brick will be published in a future number. Machines of the type shown are for working plastic or soft material, clay being first mixed in a pug mill and then fed in through the hopper seen at the rear end of the machine.

Another type of machines is for working semi-plastic material, clay that is only dampened, fed into moulds and subjected to intense pressure. There are also machines for second pressing bricks after they have been moulded in the usual manner; pug mills, disintegrators and other accessories that make up an extensive class of clay-working implements. We neglected to mention at the beginning what are called "building blocks," such as are extensively used here in this City.

THE DRAINAGE OF NEW ORLEANS.

Those acquainted with the City of New Orleans, its environment, topography and history, will not wonder when we say that its drainage will be the most extensive problem of the kind that has ever confronted any city in this country.

A portion of the area to be drained is twenty feet below the flood level of the Mississippi River, protected by an embankment of porous earth through which there is constant percolation or seepage it is called, while the storm water that has its maximum about the same time with the river floods, makes up an appalling volume, that has to be raised by artificial means.

At present, and for forty years past, there have been in use five draining stations that raise the water from an area of 13,000 acres high enough to cause a flow back into Lake Pontchartrain through canals about six miles long. The machinery in these stations is with one exception what may be called the old Dutch wheels, and if of modern construction would be tolerably efficient for low heads, but all this is by no means sufficient to drain the whole area required, the head in some cases being much more than such wheels can deal with, and the required volume several times what the present machines can handle.

This great undertaking has taken form by the appointment of an advisory board of engineers who have completed a survey and arrived at the main data involved, also have recommended that the water be discharged through Bayou Bienvenu into Lake Borgne instead of Lake Pontchartrain, with lifting stations, five in number, to substitute grade and produce the required current.

It has long been conceded that Lake Borgne, which lies about 12 miles to the eastward, is the best or natural out-fall for the drainage of New Orleans, and also for an approach if a canal was cut from the city to the lake. There has also been a great deal of consideration and writing upon the subject of diverting in part the waters of the mighty river through Bayou Bienvenu into Lake Borgne.

New Orleans drained would be a new city, and in some respects an ideal one in the winter. It has suffered during and since the war, from nearly all the adverse circumstances that can be imagined, including the loss of a river commerce that built and maintained the port down to the railway era. It has also been afflicted with municipal dissensions, and inherited in full degree the curse of war.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO."

No. XXXIV.

POPULATION WANTED.——THE LEAD-PIPE CINCH.——PIONEERING.
A NEW-MADE COUNTRY.——A MAN FROM BOLIVAR.

——————Before going farther down the Pacific Coast one may observe here fully the nature and trend of what we may call the local civilization, not that this term applies to what is meant, but there is no other at hand. The key note is found in two things, immigration and imitation.

There is continual effort to imitate the Eastern States in a country where climate, products and other natural conditions are different. There is, of course, a good deal that is original, but the latter is forced and not induced. This is natural, from the maintenance of highways and schools down to the hitch of a harness, but the immigration matter is not so easily accounted for.

In San Francisco we are informed there are regular societies to promote immigration, and one can hardly run over a serial publication of any kind here without finding something about "more people on the Coast." This may be a desirable thing, but I think not. People have come here much too fast as it is, long before there were means to employ, regulate and govern them, and while much of the required machinery of population was wanting. This remark need not, however, be confined to the Pacific Coast. It is common all over the country, and one may ask and ask for some logical explanation without ever receiving anything of the kind.

Population is not strength, unless made up of "solid men." The imported thousands that come from Europe and Asia, with other thousands that are bred up to ideas engendered by this immigration, in politics for example, are no gain to a people, and I believe that if the population of the United States had not increased a single soul in twenty-five years past the country would be in a much better condition than it now is. As this has no hope of proof it is given for what it is worth as an opinion, an honest one at that, but the query is, where did this craze for population come from, and what is its incentive?

With this cry for people has come about circumstances that repel nearly all except the dependent classes. One result is the difficulty

and almost impossibility of operating with small capital, or by individual effort. It takes a "company" to do anything, and the company must be rid of competition if possible. A droll kind of a man we met as a fellow-traveller had studied these circumstances, or rather had discovered them. Here are some of his remarks as near as they can be remembered:

—— ——"People about here when they do business want a 'lead-pipe cinch' on what they are about, and they get it, not by monopoly always, but in another way. When a poor man, or any one man, starts a business he must put up the capital, and must meet the assessor when he comes around. He may make ten per cent. a year, perhaps more, and a company must do the same, but does the company put up capital? not much; they just figure it out. What money they have is borrowed on the bond dodge. The shares represent nothing, or a good deal less, except to swell the investment account. This is financiering, and to divide ten per cent. on the watered stock fifty per cent. must be earned on the real capital, hence there must be a 'cinch' somewhere, some kind of charter, privilege or right, which one man cannot command. The small man must be kept out of the way, and he is smashed somehow, hence our enterprises are large, large in many ways, and a poor man has only the privilege of wages, and not that in many cases."

The "lead-pipe cinch" was a curious but expressive phrase, and describes perhaps too strong an idea of business that has grown out of the speculative era here, and is the bane of this country, as well as a good deal of the Eastern part. It was well illustrated by a stove-maker we called on:

"I did pretty well," said he, "until they scooped me with capital. I was in the way, and they just shelved me. All I own here is my clothes. The store across the way has my foundry. Money is dear here and I did not have much, so could not sell on credit, but the merchants use credit where money is plenty and cheap. A stove foundry in Troy, New York, can borrow money at half what I can. Their agents here take farmers' notes at twelve months for stoves, and send the notes East as collateral, or to sell as an investment. They soon scooped me."

I submitted the droll man's notes to my Uncle, who I found had been already carefully observing the same matter. "Tech," said he, "that note-book of your's is of no use in the present case. You might as well try to dock a ship in a wash tub. It will require some reams of paper to deal with this matter. You have struck the

great economic problem of our time, coming like an avalanche, and you can only look and wait to see what turns up next.

"The 'lead-pipe cinch' is no myth. It is a fact, and has another name, invented by Mr. Gladstone, who calls it an 'inequality of human conditions.' Where population is fixed, or nearly so, and where the opportunities of nature are watched and held in some equitable way, the inequality is not so marked, but as you go toward the edge, where things are new, prices unfixed, and the opportunities of nature are exposed to personal or corporate conquest, there you will see the 'lead pipe cinch,' as your friend called it, also will find the struggle for existence intensified. Markets are narrow, population not assimilated, the sentiment of sympathy is weak, and people act like a multitude floundering in the water, each one trying to keep afloat by pushing the next man under. Laws are weak, or not enforced, and the race is exemplified by the 'devil take the hindmost.'

"Better end this topic right where it is in your notes, and write under the cut-off line: 'If you want to be contented, fairly treated and happy, never live where the population of a country is rapidly increasing; keep to where there are sidewalks, gaslights, good roads and a fixed population, and let others do the pioneering business. They are fond of it, crazy for it indeed, and there is no lack of recruits.'"

I took his advice in so far as the present, but hope to learn more of this lead-pipe cinch matter before we get through. This "inequality of human conditions" is a striking name and theme.

———The making of railways up and down this Coast calls for fortitude, and might well excuse a little water in the shares. As, however, any ideas set down here belong to my Uncle, it is but fair to transcribe his remarks on the subject.

"This country," said he, "is wholly unlike the Atlantic Coast. That is flattened out, settled down, and was finished thousands of years before this job began. It is all volcanic here and to the south, increasing as we go on, that is, more recent, and the whole structure is as if it had been shook up when hot and set down to cool. You don't see much surface evidence here in Oregon. It is a little older, but wait until you get to the Bay of San Francisco and thereabout, and you may run through miles of lava that has not been disintegrated enough to form a skin of soil. Some places you will imagine yourself passing over an old furnace dump. There is scoria, puma

and a lot of other matter with Latin names that we common people call slag when it comes from a furnace. There are whole counties of it in California, some of them not very well settled yet, because it is not long since some of these volcanic centers were shaken out of semblance.

"Up here there is a good deep surface strata, as the dense timber growth proves, but pretty soon you will see no more of this dense timber growth, except in valleys where the detritus has made depth enough. To build a railway here is a job, of course, and there is not only the physical impediments to construction, but the useful surface or area to be served is limited in the same proportion.

"They do not need railways up and down this Coast in such places as from San Francisco to Portland and Puget Sound. Nothing but an inadequate and law-harassed sea service permitted it. There is no finer chance in the world for a coast steamer service that railways could not touch, but it does not exist. The vessels are just large enough to induce seasickness, and long enough at sea to make it aggravating. A steamer should be at sea only thirty hours or so between Portland and San Francisco, and if of the first class, and large enough, very few would patronize a railway train that is nearly as long on the way.

"Watch these valleys, or, what is better, look at your maps, and you will see that instead of leading to the ocean the common course is parallel to the Coast, another sequence of volcanic architecture. Look at the great valley of California, stretching 400 miles parallel to the Coast, the high ridges, with a lava cap hundreds of feet thick on top, and buried stream beds beneath where the miners delve and tunnel for gold. It is a queer country geologically, and in a good many other respects."

——We went down the Coast by train, not by choice as a means of travel, but to see the country, and were much interested in various things on the route, especially when we passed Shasta, a snow-capped mountain, and descended into the valley of the Sacramento River.

The transition from the fir belt, just below the snow, down to a tropical country in a few hours' run was amazing. As, however, this change is due less to altitude than the effect of winds and sea influences, the two things must be kept in mind. Get behind a mountain here, and you can plant figs and oranges. Go on the other side and none of this. Twisted trees and chaparral, cold too, and dried out in summer. I have seen somewhere a weather table

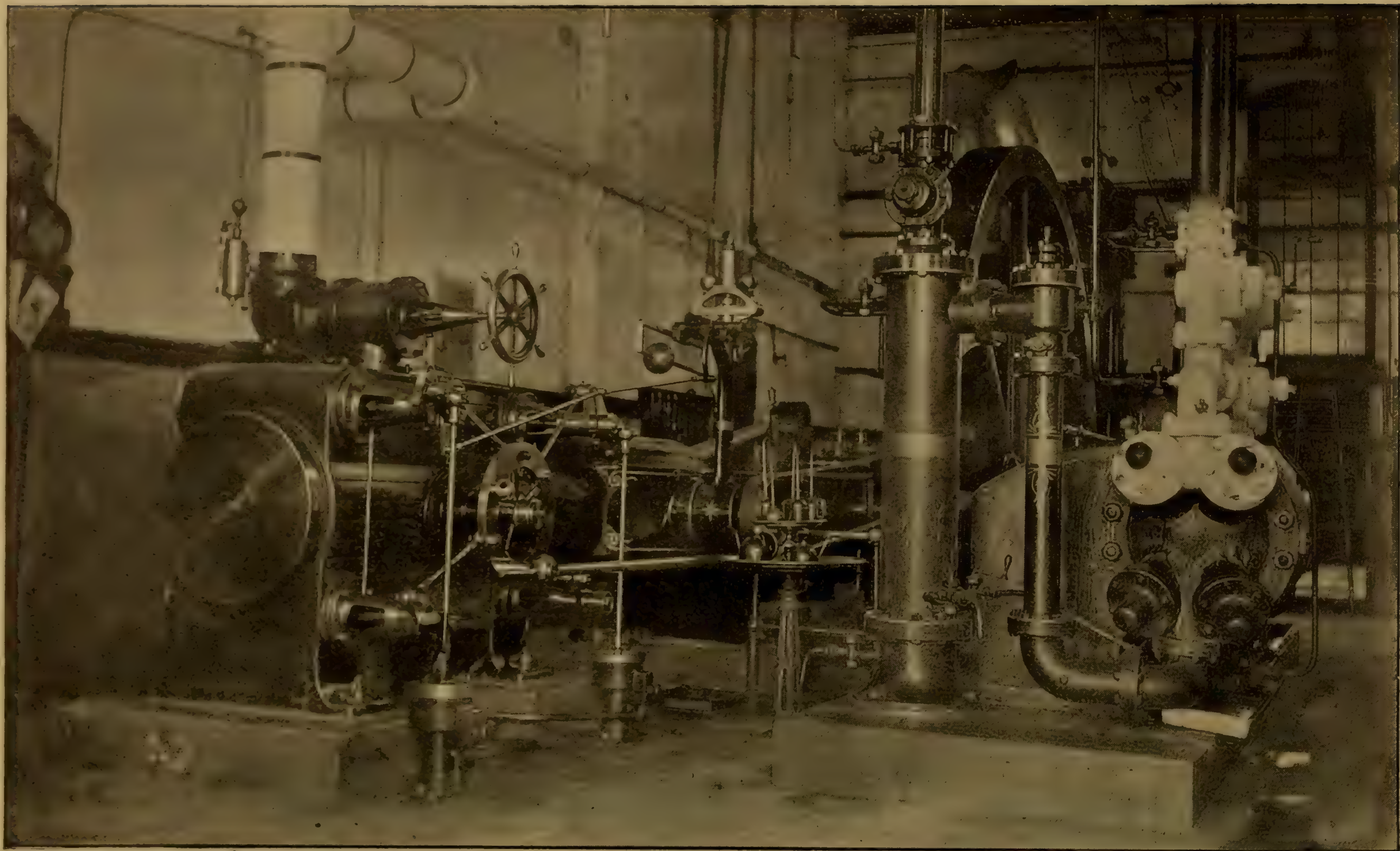
made up from observations under the lea of a mountain 2,500 feet high, only ten miles from San Francisco and five miles from the sea, that corresponds to climate 500 miles south of there. The rainfall was double as much on the lee side of the mountain.

———————The Sacramento River occupies or runs through a wide valley, draining hundreds of square miles of alluvial lands fertile in a high degree, and so dear in price we are informed that when bought at this day will not return taxes and interest, not an unusual matter here, however, in investments, because the real facts of production are not known, or are too irregular to be estimated. People proceed on the assumption of maximum crops and high prices.

Wheat, the principal product, is measured by the cental of 100 pounds, which is sensible. In ten years its value has gone down from 1.75 to 1 cent a pound, or 60 per cent. In this disappeared all the profit, and with it some of the cost of production, as it is figured or as it really is here. Wheat from being a surplus product of farmers has become here and elsewhere in large wheat-growing districts a "manufacture," conducted with and having all the characteristics of "company" operation, consequently without that element that founds and cements a community, the farmers' homes and villages. In this matter we met with what is the great and controlling characteristic of this portion of the Pacific Coast, and discovered it at first from a fellow-passenger who lives in a Sacramento valley village. I have his words set down very nearly as delivered, except the name of the town, which is changed.

"I live in Bolivar, or what was Bolivar, in the valley. It was a kind of mixed town, a little farming, gardening, stock raising, blacksmithing, wagon and harness making, cooper shops, shoe making, and the like. A main road from the foothill mines passed through the town, and the tavern did a great busines. Every man was at work. There was plenty to eat and wear; money too; churches, school and all this, but it ended. Rich men we had never seen got the land all around and made it into great farms. The railway built a branch through our main street. People came from the City, and set up two great stores, one for the men and one for the women.

"A ramshackle train carrying people, merchandise and cattle came once a day crawling through, and charged ten cents a mile to travel in a box car, and for freight more than the wagons got twenty years ago. The shoemaker, blacksmith, cooper and carpenter shut up their shops. Rich men's sons from the large farms make the town



Ammonia Compressing Plant.—The Lane & Bodley Co., Cincinnati, Ohio.

their evening resort. Bars, beer halls, game houses and the like sprang up, and Bolivar is the wretchedest place you can find. Not one man in ten works. There is nothing to do but to loaf around. No one builds a house, no one has any money, and what is wanting is a big fire, and then a wheat field on the ground where Bolivar stands."

This was undoubtedly what is called about here a mining town. They all rise and fall with the mines.

(To be Continued.)

AMMONIA COMPRESSOR PLANT.

THE LANE & BODLEY COMPANY, CINCINNATI, OHIO.

The plate on the page opposite shows a very complete plant erected for the Arctic Ice Company, at Cincinnati, Ohio, by the Lane & Bodley Co., of that City. The plate not only shows to advantage what is a very extensive and complete plant, but is a fine example of photoplate reproduction.

The engine, seen on the left, is of the Corliss type, 22 inches bore, 48 inches stroke, connected by the same crank shaft to a Lind compressor, seen on the right, having a bore of 20 inches, and stroke of 30 inches, with a capacity of 70 tons of ice each day.

There is a harmony of arrangement and parts that is creditable to the designers, and there is a result of steam efficiency, shown in indicator diagrams sent, that we almost fear to engrave. They seem as if plotted geometrically.

The Lane & Bodley Company about fifteen years ago set off their Corliss engine work in a separate building and department, and by careful attention to all constructive details have made a great success of this branch. Visitors at the Chicago Exhibition will remember the fine example of a compound Corliss engine made by this company, and employed to drive a portion of the motive plant.

ARTESIAN WATER.

The Piedmont tunnels and the Alvarado artesian wells furnish for the City of Oakland an unique water system that goes to prove a commonly-entertained opinion that the water comes from the

Sierra Nevada Mountains, crosses the San Joaquin Valley, and rises again at the Bay hills. Of course one is not obliged to accept this theory for the source of the water, but it is plausible, and is proved to some extent by well holes on the route.

At Stockton the supply for 15,000 people is drawn from about sixty wells of various depth, from 500 to 1,500 feet, supposedly sunk alongside of a fissure, because varying in depth and flow when only a few yards apart.

The Piedmont tunnels, four in number, are from 150 to 300 feet in length, and flow about 400,000 gallons a day, that rises from the bottom of the tunnels, giving evidence of the inversely-curved strata that carries water from the mountains to the tops of the Oakland hills and to the wells at Alvarado. The course or fissures are not the same, because the Alvarado wells do not discharge at the surface, which is near the level of the Bay, but are drawn off about eight feet below, or about the Bay level. The wells, ten in number, are 16 miles from Oakland, all within a radius of 3,000 feet, and flow at the rate of 15,000,000 gallons daily.

The water is pumped to Oakland by steam power through a riveted pipe, 30 inches in diameter, made and laid by Messrs. Francis Smith & Co., of this City, who were the contractors. The supply seems to be unvarying, and is a curiosity of nature, as are indeed all flowing artesian wells, because no one can imagine by analogy to surface phenomena how under such immense pressure water fissures can exist throughout a distance of hundreds of miles.

A map of the artesian district around the Bay of San Francisco, with the levels and pressures of the wells, might furnish some clue to the source and nature of this water supply, but in the absence of all but conjecture we must concede the Sierra Nevada theory, which is plausible compared to some other cases, that at Chicago, for example.

A NEW METHOD OF RAISING WATER.

The Merrill Manufacturing Company, of New York, who have works at Bound Brook, New Jersey, are making apparatus for raising water that has special application to circumstances here in California. The scheme can be generally stated as one of air transmission, wherein the motive power is applied to air forced through a small pipe to a pneumatic vessel at the source from where the water

is to be raised, and there acts automatically to expel and force the water without any pistons, valves, or other devices subject to wear or derangement.

The plant consists of motive power, which can be a wind wheel, an air compressor and expulsion chamber before described, with a small air-conducting pipe laid along with the uptake or water-supply pipe.

The importance of the system rests on several features, chief of which is that the motive apparatus need not be set up at the source of water supply, but at the point of delivery, or in any other convenient place where the machinery can be easily attended to and at trifling expense because done in connection with other duties.

ORIGIN OF CONVEX TURBINE VANES.

In some writings on the subject of turbine water wheels last year we asserted a belief that the reversely curved receiving vanes for such wheels originated with the Risdon Water Wheel Co., of Mount Holly, N. J. This view is confirmed in the following letter from Mr. Tyler, of Springfield, Ohio, himself well known in connection with water-wheel practice in this country.

To the Editor of "Industry." *Sir:* My attention has recently been called to a reprint of one of your articles from *Cassier's Magazine*. I have read the entire article with great interest, and am much pleased with it.

I write to explain a matter concerning the curves of the Risdon water-wheel vanes, to which you refer on page 23. I was a partner of Mr. T. H. Risdon from 1870 until his death in 1884. All the patents were taken out jointly by he and myself. There was at the time already in use a Tyler wheel similar to the Risdon, otherwise the latter would have been called the Risdon and Tyler turbine. Mr. Risdon was making the Van De Water wheel, and paying royalties to Henry Van De Water until I became acquainted with and joined him.

The upper or entering ends of the bucket of the Van De Water wheel were radial. At our best test of it the water ran through the chutes of the case with 50 per cent. of the velocity due to the head, while the wheel ran with 75 per cent. of this velocity, that is, the wheel ran one half as fast again as the water. The wheel was the faster moving body, and the square or radial vanes must have dragged on the water, and this would make the wheel run too slow.

A vane placed in the current flowing from the wheel showed that the water after leaving the vane whirled in the opposite direction to

which the wheel turned, because the wheel did not move forward as rapidly as the velocity with which it discharged the water backward, hence we decided to give the vanes the curve, which was always afterwards adopted.

When we tried it the efficiency or economy of water improved from one to five per cent., varying in different wheels. The power increased more than the saving of water. The speed of the best economy was higher, showing that the water had dragged on the old radial or square vanes. The vane in the discharging current became vertical on account of the increased speed of the wheel, and the wheel received more water.

T. H. Risdon had limited educational advantages, but was a natural mathematician. The curves of the Risdon wheel were laid out by myself. My father and two brothers were and are college professors, and their mathematical knowledge with my own here came into use; we knew precisely what we were doing. I laid out the curve so that it would be the exact path of the water entering the wheel, and so the bucket would only divide the water at the receiving end.

Not only the Risdon Co., but also the Dayton Globe Iron Works (formerly Stout, Mills & Co.), the James Leffel & Co., and the Stilwell-Bierce and Smith-Vaile Co. on their Victor wheel have all adopted the same curves for the receiving ends of the vanes. The gain from it is so small that it can only be detected by a very accurate test, and hence it has not been taken up by the water-wheel makers.

If I have not made myself clear I shall be glad to write farther. I believe that you desire to do justice to T. H. Risdon and to me, and so have written this letter.

Yours Very Respectfully,

WILLIAM W. TYLER.

Springfield, Ohio, September, 1895.

Mr. F. M. Rites, an able steam engineer with the Westinghouse Machine Company, has recently designed an air compressing engine, or rather has connected a Westinghouse engine into an air compressor, in a very ingenious and simple manner. The pistons which are of the trunk kind, are in two sections of different diameter, the annulus between being for steam. The tops or largest ends of the pistons act as for compression, in two stages, first in one and then in the second cylinder. What the thermal results may be we do not know, but Mr. Rites has certainly succeeded in "leaving off" a third or more of the mechanism usually demanded to make up a steam driven air compressor.

LITERATURE.

Those sending books for notice in this department are requested to mark in review copies the price at which the book is sold.

The Mineral Industry.

Its Statistics, Technology and Trade,

Vol. III, 1894.

EDITED BY RICHARD P. ROTHWELL,

Editor of the *Engineering aud Mining Journal.*

This third volume, the preparation of which has been before noticed in this department, has been received, and is upon the same extensive scale as its predecessors, and is in itself an independent volume, supplementing in many ways statistics previously given, but not repeating them.

The main portion of the work, occupying 700 pages, is made up of essays on various branches of the mining and mineral industries by men eminent in their various departments. The contributors, over fifty in number, have each a short personal notice to explain their qualifications.

Mr. Rothwell begins the volume with an introduction containing a summary of the mineral productions of the United States in 1893 and 1894, from which it appears that the total is $615,847,108 in 1893, and in 1894 was $553,356,499, showing a decrease of $62,490,609, or about ten per cent., but this, as the author admits, is not a shrinkage of quantity so much as of values.

The increase of gold produced in 1894 was $3,809,708 over 1893, and $6,749,727 over 1892. The distribution of these quantities, also of other mineral products of the same period, are set forth in tabular form in the body of the work.

One of the most notable sections is that of Mr. E. D. Peters, Jr., on "Some Recent Improvements in the Metallurgy of Copper." No adequate synopsis of this can be given in the space here at command, and the same conditions apply to the other essays, most of which are comprehensive and lengthy.

One feature of the work, which contains 770 pages, is the complete index, which enables ready reference, geographical, technical and statistical. In fact the whole is done in a most commendable form at great expense, and is worthy of wide dissemination among all those concerned in the mineral industries of our country.

The work is published by the Scientific Publishing Company, 253 Broadway, New York. Price $5.00.

Alternating Electric Currents.

BY PROF. E. J. HOUSTON AND A. E. KENNELLY, SC. D.

[The W. J. Johnston Co., 253 Broadway, N. Y.]

Electrical literature is following in the path of other sciences, when they are fixed enough to admit of treatment in a "series" of essays, dealing with branches or divisions uniform in size, and constituting an epitome of the art convenient for handling and reference.

A difficulty in preparing such a series is to secure a presentation of the subjects in a rudimentary form by those advanced in the art, and this, we imagine, is especially the case in the electrical field.

The present volume of 204 pages, the first of ten to be published by the W. J. Johnston Co., gives evidence of a careful attention to the conditions above indicated, being written by those eminent among electrical engineers, yet on a plane adapted for popular understanding.

The make-up is happily arranged as to type, size and dress, and the publishers will no doubt find this one of the most popular among their large list of electrical works they have issued. The price is one dollar for each volume.

Examination of Water.

BY PROF. HENRY LEFFMANN.

This work of Prof. Leffmann's has reached a third edition, and this is not to be wondered at. It would be hard to name in the field of experimental science any function of more importance than the determination of the quality of drinking water. It has more to do with life and health than food, because equally an essential, and almost without indication of quality that our senses can detect.

On this Coast, where the country has been heaved up by volcanic action, and it is an exception to find subterranean water not charged with some kind of mineral, the subject of water analysis has special importance. The thousands of thermal springs are

an evidence of chemical reactions that take place in the diversified water bearing strata, and while happily the minerals held in solution are not as a rule deleterious, it is well that their character and quantity be known.

Very few among even competent chemists are prepared to analyze water, especially what we call pure water, and it is here that the especial usefulness of Prof. Leffmann's work appears. His wide and consummate experience is shown by the brief and perspicuous manner in which he treats the methods and apparatus required for investigating and determining the various elements, mineral and other, that are to be found in water of all kinds.

Potable water he divides into rain water, surface, subsoil and artesian water, and begins with the statement that "pure water is an artificial product," which when we come to think of it is certainly correct. Water filtered through earth strata of almost any kind must take up the contained salts and to become pure requires such filtration.

The work is not, however, an essay on the nature of water, but a practical guide to the best methods of analysis, intensely practical, we may say, without a waste sentence.

It is published by P. Blakiston & Son, 1012 Walnut St., Philadelphia. Price $1.25.

Laws of the United States Relating to Navigation and the Merchant Marine.

Part II of the Report of the U. S. Commissioner of Navigation.

The issue of this document by the Honorable Eugene T. Chamberlain, Commissioner of Navigation, is timely, and should find wide circulation among those concerned in maritime affairs in this country, not only to give information respecting amendments and revisions, but also to convey an explanation of the scheme or spirit in which these laws are founded; we mean especially in respect to their economy.

We cannot attempt in this department to more than comment upon the arrangement of the present volume, and its copious indexes that constitute it a ready medium for reference, not only to the statutes, but to lists of the various Acts of Congress, districts, ports of entry, officers, executive, consular and other, connected with marine matters.

In future numbers, as space will permit, we propose to quote and comment upon various provisions that have earned for these laws the charge of being two centuries old and of being the main cause of the decline and almost annihilation of the American foreign shipping interest; causing, with various State laws, American vessels to be sailed under foreign flags. Many things have been changed, it is true, but more remains to be done.

Between 1884 and 1894 there were about forty Acts of Congress modifying or affecting the Navigation Laws, in most cases loosening the paternal grip upon the merchant marine that reaches away back to the ordinances of 1787.

Report on the Total Eclipse of the Sun, April 16th, 1893.

BY PROF. J. M. SHAEBERLE.

Astronomer Lick Observatory, University of California.

[State Printing Office, Sacramento.]

This remarkable observation, described in graphic terms by Prof. Shaeberle, was made in the interior of Chili at a place called Mina Bronces, where the expedition remained six weeks under circumstances that were, to say the least, not a pleasant outing. A light telescope, 40 feet long, with thirteen cases of instruments and accessories, had to be transported over a rough mountain country, and set up at an elevation of 6,600 feet above the sea.

The first 30 pages of the report contain a very interesting narrative by Prof. Shaeberle of the circumstances of travel and fitting up the station of observation. The remainder of the 126 pages is mainly taken up by the technical notes and results, enriched by ten plates that to one not an astronomer are beautiful and mysterious.

The expedition was wholly successful in so far as its objects, and bespeaks much praise for the care and energy of Prof. Shaeberle. Much of the time the party were exposed to a temperature far below the freezing point, and sometimes below zero. At one time they camped at an altitude of 16,000 feet, and once reached 17,000 feet.

The following is a quotation from Page 25, describing the physical effects produced in the attenuated atmosphere of the high Andes:

"No adequate idea can be given to the reader of the sensations one experiences in climbing at great altitudes. The physical effort required to raise one's own body causes such a palpitation that the climber is obliged to rest every few minutes. The heart is thumping at an alarming rate, and with such force that the sound alone causes a sickening sensation to its possessor, who is constantly expecting something is going to break. But so long as the body was physically capable of obeying the commands of the will, so long was it resolved to keep on towards the top. The native with 30 pounds of instruments on his back seemed to have but little difficulty in scaling the rocks."

Mrs. Phebe Hearst, of San Francisco, contributed the sum of one thousand dollars in promoting the expedition.

Coal-Handling Machinery.

A neatly-prepared pamphlet on this subject has been sent by the C. W. Hunt Co., of New York, and while a trade publication it has a good deal of interest as a technical treatise on this subject, including drawings of a number of plants to serve steam furnaces.

Some of the mechanism is extremely ingenious, and special in its nature. The general plans are so varied as to constitute each case a study. The pamphlet will be sent to any one interested in handling coal from vessels, or in any other manner, if application is made to the company, 45 Broadway, New York.

Guide to the Yukon Gold Fields.

BY V. WILSON.

This considerable work, published by the Calvert Company, of Seattle, Washington, is as useful as it is unexpected.

No one supposed that a traveller with Mr. Wilson's powers of observation and description would endure the risks and discomforts of a journey through the mysterious valley of the Yukon River, prepare maps, photo-plates, and so on, without a hope of readers much more numerous than can be expected for a work dealing with an almost unknown region. The work is, however, well done, and is ingeniously a blending of a tourist's guide book and a miner's hand-book, and a fair essay on the physical and geographical features of the Yukon country.

The work is embellished with 72 plates, which in most cases were happily caught with a camera and well reproduced in the letter press.

Mr. Wilson, whose untimely death occurred at the time of publishing his work, thus explains his purpose in the undertaking:

"No attempt has been made to put forth a literary production. A statement of facts in simple language has been followed. It has been left to some tourist of the future to give to the public a volume embellished with rhetorical figure and lofty description. This volume is intended for a hand-book to be used by every one, tourist, prospector and miner, for ready reference, telling how to get into the Yukon basin, how to get out of it, and what has been found there.

It is not only the purpose of these pages to give such information as will prove of benefit to those who may undertake the trip, but also to discourage those unfit to encounter the hardships, and correctly to inform those who have been lead to believe that nuggets could be gathered from the beds of streams like pebbles."

We cannot, of course, go into the facts and matters here presented. It is not necessary, and our notice must contain for a principal feature that we have read the book through with great interest and profit, and can recommend all readers of "INDUSTRY" to do the same.

It can be ordered from the Calvert Company, Seattle, Washington, or procured from booksellers. Price $1.00.

The Province of La Rioja.

ARGENTINE REPUBLIC.

This book, of which several copies have been sent to the editor, is one of a number published by the Department of Immigration in the Argentine Republic, and is one we think could profitably be studied by those who want to promote desirable immigration into California.

The information given seems exact and careful. There are no periorations on glorious climate, freedom and wealth lying around to be gathered up like stones, but careful statistics and explanations of lines of travel and its cost, of the laws of the country, taxes, crops, care of the indigent, public aid, when and how given, all written in admirable style, perspicuous, and, as before said, without a word in the whole book that we can find appealing to imagination.

The statistical matter we cannot deal with. This year the people there are importing our combined California harvesting machines to cut their wheat, as was learned in Stockton recently.

It is annoying to have to admit a superior sagacity and fairness in the methods here set forth, also to admit their success in a land only two years ago wrenched by internal dissention and commercial panic, but the truth is that the Republic has drawn mainly from Latin countries a population that seems to be very progressive.

One particular seems wanting in these books, two of which we have examined, that is the value of land. Without this there must be an element of doubt in all the rest. These books are procurable from the Office of Immigration, at Buenos Ayres, Argentine Republic.

Serial Publications.

Electric Power.— The September number of this Magazine shows progressive improvement in all the features that commend such literature. In fact it has been carried, as we may say, to the point of permanent technical publication, with incidental division into numbers.

Journal of the Franklin Institute.— The September number contains a report of the Committee on Science and the Arts respecting the Pelton water wheel, and therewith an appendix by Mr. J. H. Cooper, of the Committee, giving an interesting history of the rise and development of impulse wheels.

There is also a valuable paper by Prof. S. P. Sadler on "Asphalt and Bitumens," and correlating therewith a paper from the chemical section of the Institute on an investigation of "Gilsonite," a kind of asphalt found in Utah.

Consular Report, No. 179, for August, 1895. — It is surprising, as it is commendable, that these reports of the State Department should be brought down so nearly to the current date. It is evident that the matter requires time for compilation after its receipt from consular officers, but the letters have dates only a few months earlier.

The first section is devoted to "mozanite," a refractory mineral found in North Carolina, and exported to Germany, which seems to be the sole market at this time. It is found in the beds of streams, and washed out much in the same manner as gold in placer mining. The specific gravity is from 4.9 to 5.3, and the chemical symbol Th O^2. It is a phosphate of cerium and lanthanium, and perhaps exists on this Coast. It is employed as a substitute for thorium in making flame-resisting shields or mantels to enclose gas burners or flame lamps on the Auer-Welsbach system, known to most of our readers.

Transactions of the American Institute of Electrical Engineers, June and July, 1895.— This bi-monthly issue of the society's transactions contains mainly the proceedings at the Twelfth General Meeting, held at Niagara Falls in June last.

The paper of most interest to readers of "INDUSTRY" is that of Dr. F. B. Crocker on "Electric Power in Factories" or, as he should have said, "Electric Transmission in Factories," a distinction that if adopted would prevent no end of misconception in a popular way.

The makers of machine tools, in their proverbial conservatism, have been slow to provide for impelling motors as an integral portion of machine tools, to be employed or not as occasion might demand.

The makers of elevators or hoisting apparatus proceeded at once to incorporate the electric element in their machines, adapting one part to another, but machine-tool makers seem to have got no farther than a shelf somewhere on the main frame to set a motor on, and connect it by a band. There are some exceptions it is true, but not many.

In the paper is given diagrams showing the loss of power by line shafts that is inexplicable, and is improperly named, because the idle period of connected machines is included in the losses by friction, which are set down at 75 per cent. The estimate of such losses must include the actual resistance of machines, which we imagine is not known. It will be hard for any one skilled in the erection and operation of workshops to accept such an estimate, or anything very near thereto.

The present number indicates a continued interest, energy and ability of the Society.

LOCAL NOTES.

The mineral oil output at Los Angeles, Cal., reached in September 2,500 barrels a day, and new wells were being put down at the rate of twenty per month. The investment was rated at half a million dollars. This will soon attract the attention of the Standard Oil Company, if it has not done so now, and the railway companies will also have an interest, as it stops shipment from the Eastern States. The stock of oil on hand in this country was in 1892, 17,000,000 barrels, in 1893 it fell to 12,000,000 barrels, in 1894 to 6,000,000 barrels, and is now not more than 4,500,000 barrels, so the Los Angeles source is opportune, and cannot be swamped or "scared off."

The *American Engineer* is to be issued fortnightly hereafter, twice a month. No one will think that the *Engineer* needs improvement, it stands now at the head in age, make-up and originality of its matter, but the editor and proprietor, Mr. M. N. Forney, no doubt finds that railway matters, to which the journal is largely devoted, move too fast for a monthly publication. The "*American Engineer and Railroad Journal*" dates back to 1832, and is the oldest railroad publication in the world. It has absorbed at one time or another several other publications, among them *Van Nostrand's Magazine*. The *American Engineer* will always be welcome by its friends in whatever "form" its owner chooses to issue it.

Col. Geo H. Mendell, of the United States Engineer Corps, who has for twenty-seven years been in charge of Government engineering works on this Coast, retired on his birthday, the 12th of last month, at 64 years of age. The rule of age is perhaps the only one for the retirement of officers, but on many grounds it seems anomalous to dispense with the services of an officer just when, as in Colonel Mendell's case, he has attained the zenith of his powers and usefulness, but there is the countervailing consideration that his professional life continues, and is only transferred, so to speak. Of Colonel Mendell's career we need not say anything. It is well enough known, but there is one circumstance we cannot help mentioning. About five years ago when we were at his office he said: "I have signed on that desk vouchers to the amount of seventeen millions, and no man has ever thought or charged that one dime of this money was not paid for its legitimate purpose and without any reference to personal objects."

The Union Iron Works are now adding extensively to their machine-tool equipment, a policy that is exceptional at these times, and one that indicates work to be done and confidence in the future.

One lathe recently added turns 50 feet long, and receives work exceeding ten feet in diameter, a fine tool for marine and other large work, made at the Industrial Works, in Philadelphia. This lathe weighs 350,000 pounds, and is by far the heaviest on this Coast, perhaps the largest in the whole country. There is also a new wheel-cutting or wheel-planing machine for bevel gearing, a heavy and expensive machine that produces true wheels of any bevel or size. There are also other new implements, required for special and general work on the latest methods.

We have received from Mr. L. P. Degen, of this City, a communication in respect to leather belts for machinery, in which it is claimed that this industry is a principal one in San Francisco, carried on with all the improvements in processes that are known, that the leather used is made here, tanned with native oak bark, and the best running belts on electrical machinery in this City are made here. These are considerable claims, which we believe to be true, indeed know that in methods the makers in this City have many ingenious expedients invented and patented by themselves, and moreover that a considerable export trade is done in leather belts, not spasmodically, but permanently, and we are glad to make these facts known to local and other consumers. There is no other thing in the supplies of a works where the question of quality is so continually present as in belts for machinery.

The Blue Lakes Water Company, mainly owned in this City, is a quiet corporation compared to the amount of their property and the extent of their plans. They own water rights and works that are stupendous when the head or position of the water is taken into account. They are heading for Stockton, Cal., and as a preliminary movement have acquired the water works in that city. The water sources are high enough in some places to flow into Nevada, and in coming into Stockton there will be a necessary "drop" in the system that will afford power enough to drive all the machinery in Stockton, and light the city besides, the water then going on under a good service head. Our opinion is that the Blue Lakes Company have other and farther ends in view, and may before it is ended offer their melted snow water for sale in Oakland and this City. At present they supply most of the Amador mining companies with water for power, and are wasting now in useless descent from 6,000 to 10,000 horse power.

We examined last month at the Risdon Iron Works, in this City, a hoisting engine constructed for the Merced Gold Mining Co., Mariposa County, in this State, that represents the most advanced practice in this class of machinery, in fact it must be a culmination, because without complication, all adjustments are controlled by power, and it is an exemplification of the saying: "Touch the button and we do the rest." From an elevated platform between the

engines an attendant, by means of levers that indicate instead of perform any part of the work, has complete control over speed, braking, reversing, starting and stopping. The hoisting speed intended is from 1,800 to 2,500 feet per minute from a depth of 2,000 feet. One thing especially notable is the vast difference in design, material and workmanship compared with what would have been good mining machinery a dozen years ago, when a plant like the present was not thought of, and if designed could not have been carried out in the same manner.

The recent experiments in "scooping up" people in front of the electric street railway cars reminds one of the old Saxon idea of greasing and putting away an ax that caused a wound. A person "scooped" would be injured, perhaps not so much as if run over, but the remedy lies in another direction, that of stopping the cars within such distance as their weight and adhesion will permit, and in regulating the speed at which they run. To do this the armatures must be eliminated when an emergency stop is necessary, and this is certainly not a very difficult thing to do.

A visit to the Union Iron Works last month disclosed the fact that the whole of the vast resources of that company are not enough to execute their present orders without night work. The immense machine shop with 60,000 square feet of floor, equal to one and a half acres of area, is packed with men and work. The foundry is full, so is the forging and plate work departments. The City branch, where 60 men are employed is also busy, and the ship yard is in the same condition. There is under construction there an oil transporting steamer of high class to carry 6,000 barrels of oil; eleven steel barges for the Amoor River, each 240 feet long to carry 500 tons of freight on 5 feet of draught. The *Oregon* is in progress, and there is the usual amount of repairs and dockage. One feature of the work on hand is its size, and as Mr. Dickie claims, is mainly business such as the smaller shops cannot deal with profitably. Various extensions are now under consideration and some of them in progress.

Mr. R. H. Tweddell, known all over the world by his numerous inventions in hydraulic apparatus, especially for plate working, died in England on the third of September, at the age of 52. His useful contributions to constructive engineering work during twenty years past has been extensive and important, and his success furnishes a lesson to those about setting out in life. We can remember when Mr. Tweddell took up hydraulic machine tools, and how the impression was that such a narrow field as this could not afford much scope, but he followed persistently in this one thing, and after ten years had laid the foundation of an extensive and successful business, consisting, as we may say, wholly in the application of

hydraulic force for riveting, punching, shearing and shaping metals. This branch was not taken up however without previous training. He had a good education and served a regular pupilage in the Hawthorne Works at New Castle. His death resulted from an injury received in a fall from a horse many years before.

Chief Constructor A. W. Stahl, U. S. N., who was in charge here during the building of most of the war vessels constructed at the Union Iron Works, as will be remembered, was ordered to Washington about two years ago for special duty in connection with the Ordnance Department. These duties being completed Constructor Stahl has been assigned to the Norfolk Navy Yard, in charge of construction and repairs, dating from October 1st. The position is one of promotion and increased responsibility, and as we surmise means more than routine duty. Constructor Stahl, although a young man, enjoys the advantage of being a competent mechanical engineer, as well as a naval constructor, if such distinction can be made at this day when war vessels are in effect "machines" of a very complicated kind. We have on many occasions reproduced in this magazine, essays and writings from the pen of Constructor Stahl, and hope to in the future present other contributions of his relating to the mutable art he has chosen for a profession.

The people of California are no doubt growing tired of "Government by commission." There are all kinds of commissions for all kinds of things, we suspect, not so much to insure executive work being done as to find places for those to whom the State "owes a living." Government by commission has always proved a failure, and always will. The method does very well in making a particular inquiry, or doing some special work for which the executive department is too unwieldy, but permanent commissioners are another matter.

Messrs. Sinclair and Hill, proprietors and publishers of *Locomotive Engineering*, in a late number give notice that they will not permit their journal to be used as an advertising circular, and say:

"We ask those who have news or improved devices to send us photographs and drawings from which to make our own engravings. Whether they are advertisers or not will make no difference. If the device is of interest, in our judgment, we will illustrate it as much as it deserves, and no more. It is not necessary to show a whole lathe to describe John Smith's improved tool post. Spread-eagle electros 'sent out to all the papers alike,' will bring three quarters of a cent per pound for scrap in this office, unless their return at owner's expense is requested."

There is now under consideration the formation of a league among the miners of the Northwest, and the absence of such organ-

izations in this as well as some other industrial interests is difficult to explain. There is some circumstance in connection with industrial pursuits that renders concerted action distasteful and unsuccessful. We do not mention it in disparagement, but the contrary, in so far as the ethics of the matter. Mercantile business, and to a large extent banking and transportation interests are combined. This is congenial and profitable, but in manufactures it is neither. The difference must rest in the diversity of product, and its variations in quality and price.

COMMENTS.

The following is from an address delivered before the Academy of Sciences at the beginning of this year by Irving M. Scott, of the Union Iron Works:

"We pay out in effect over $2,000,000 a year for cars and locomotives, and organize relief movements because there is no work for our men to do. We import hundreds of thousands of dollars worth of copper hardware from New England when the largest and cheapest copper mines in the country are only a few hundred miles away. We buy agricultural machinery from Ohio, and furniture from New York, and send 'industrial armies' East for want of work on which to employ them. We import merchandise by the train load, while the materials out of which the imports are made are at hand in abundance. We have fifteen fewer iron-working establishments today than we had twelve years ago, while the firms importing Eastern goods have increased by almost the same number."

The Americans are celebrated the world over for clean ships. The American line that sailed out of Philadelphia for some years had the best cared for vessels in the trans-Atlantic service, both as to cabins, machinery and all parts of the ships. The same is true of our war vessels. It is told that the Emperor of Germany was so impressed by the engine room of the *New York*, which he visited at the Kiel celebration, that he sent the engineer of his vessel, the *Hohenzollern*, on board the American ship to learn tidiness and order. We have travelled on three of the four ships composing the American line above referred to, and can bear witness to the fact of perfect cleanliness. On our side of the country there are some of the coast vessels that do not belong in the category, and some that do. The *Wetmore* was one of the dirtiest we have ever seen in this port.

Secretary Morton has discovered that at the Government sugar stations, on which $500,000 has been spent in the last ten years, for three years no work has been done, and in Kansas, where one of these stations is situated, it has been still for four years. Sena-

tor Peffer introduced in the last Senate a bill providing that whoever was in possession of the machinery should be considered the owner, which was an "unpopulist" kind of measure. Not a pound of sugar was ever made, only salaries paid. The scheme was a clear loss of half a million dollars.

There was a singular law enacted during the last Congress that provided for the donation to any State having arid lands one million acres of such lands on condition that the lands were reclaimed and sold to settlers, not more than 160 acres to one person or family. Whether there was a scheme of some kind behind this has not appeared this far, but as the title is not to pass from the Government for five years there is this check in the matter. Two States, Idaho and Wyoming, have complied with the Act, it is said, and have applied for the confirmation of their claims. The Act seems to be a good one, assuming that a State is competent to carry out such work, and will deal fairly with the purchasers of the land.

A visitor at Kioto Exposition in Japan says there is little use of sending anything to Japan that can be made in that country, and he does not know of anything they cannot make, except natural products. There is no patent law in Japan, that is, there is no bureau to put into effect a patent law that has been prepared, but other nations are not quite in a position to complain. Japanese are denied citizenship, and treated as uncivilized by most European nations and by this country. Their courts are not permitted to deal with people from other countries, and even their method of taxation is dictated by the "Powers," who will not permit a duty exceeding five per cent. to be levied on imported goods, so we cannot expect that reciprocity will be considered an obligation in Japan. In 1898 under treaty provisions Japan will take her place in various international matters, among these patent and trade-mark regulations.

At the rate which the great Siberian railway is being constructed one may within five years from now buy an overland ticket from Vladivostok to London or Paris. Considering the physical difficulties to be overcome in topography, climate and the absence of supplies along the eastern end of the route, the progress is marvelous, and shows a spirit of enterprise, and also of capacity, on the part of Russia that has no parallel in our age. There will be 200 stations on the Siberian line, and 2,000 locomotives will be required for the traffic. The passenger cars will number 3,000, and the freight cars 36,000. Contrary to an opinion expressed in "INDUSTRY" three years ago the line will be, as indications now show, open to the world's traffic. The distance from Vladivostok to London or Paris is about 8,000 miles, and from here to that city half as much more. It is true this eastern terminal lacks a good deal of the

Behring Straits, and the ten year limit may yet apply, but sooner or later one may buy an "overland" passage from San Francisco to London or Paris.

It is not quite fair to pit a single run on the New York Central Railway against the numerous and continuous trips made by the English railways in their recent races to Scotland, but granting this, there is a clear gain over the time there by a run from New York to Buffalo, 436½ miles in 12 hours and 35 minutes. The average speed was 64.33 miles an hour against 63.28 miles by the English trains. The American train was heavier than the English ones, but the grades were less, and as remarked, one trip is not the same as a maintained or repeated traffic. There is no doubt that in particular cases trains are driven in this country at as great or a greater speed than in England, but the average passenger service is much slower, even if this Coast is not included in the comparison.

A writer in the *American Engineer*, of August, on the subject of the Tehauntepec Railway says the Mexican Congress has concluded a contract for the equipment of the line, amounting to $2,000,000, with Samuel Hermanos, of New York and Mexico. If so we may look for a great change in the traffic from here to the East. This route is not more than 500 miles longer than the Sunset one, via New Orleans, that carries 75 per cent. of the present traffic, and is 1,182 miles shorter than the route via Panama. The time will be from here to New York 20 days, against 14 days via New Orleans, with 2,449 miles of railway in the latter route. The Tehauntepec railway, which under proper management would become a key to trans-continental business, could have been acquired here in San Francisco some time ago, and the failure of such negotiation has remained ever since a mystery without reasonable solution.

It seems strange to read of a meeting of the directors of the Hudson Bay Company in July last, and of a dividend of $300,000. This old company was once the ruler of Northern America, as the East India Company was of the Malay Peninsula. The report of the directors forms a very complete review of the commercial conditions of the past year, and is a model of its kind. The shares in the Hudson Bay Company are to a large extent held by very old firms and families in England.

The "Ferris" wheel erected at Earls Court, in London, does not seem to be a very successful piece of engineering work. Its proportions have been criticised, and the method of driving is a failure. It seems that common chains resting in smooth grooves it was thought would give traction enough, but the wheel ran back with a test load, the chain slipping in the grooves. It does not matter much. There is neither beauty, science nor safety in such a hideous

structure, and it should not be set up permanently anywhere. It is better to go up on an elevator and look out from the roof of a high building.

In some of the main stations in London during the dense traffic of the morning and evening, at London Bridge, for example, the trains arrive at the rate of one a minute, and notwithstanding all that science and unlimited means can do, the traffic becomes congested, not by reason of incoming trains, or handling the passengers at the rate of a train each minute, but in getting the emptied trains out of the way. There is no other place in the world, and no approach to it, where so many people are to be dealt with. There is not only a greater concentration of people at London, but nowhere else that the population scatters so much in going to their homes. The City of London is deserted at night, and seems lonesome after seven in the evening. The people have gone out in the trains to return in the morning by hundreds of thousands.

All over the country, wherever circumstances permit, there are attempts to artificially raise the price of fuel. The Alabama "combine" is the last one heard from. All of these combinations are to avoid "ruinous prices," and prevent deluded people from selling their coal too cheap. San Francisco, if it were not for foreign coal, affords the finest chance of all for these fuel combinations, and if those in interest can manage to control the import cargoes, we will have to suffer for it in a degree that will cripple all interests. Already the price of coal is nearly twice what it might be at this port if mining and transporting were done at the same cost as elsewhere, but even this is not enough; a combination of two of the principal coal firms have succeeded in adding about two dollars a ton to the customary retail price, and as noted elsewhere some of the newspapers cite this as a consequence of reducing the duty from 75 to 40 cents a ton.

The Baldwin Locomotive Works are to make 40 locomotives for the Russian Government, twenty for passenger and twenty for freight service. These are for use on the old government lines, and will no doubt be an opening for contracts of the same kind in the near future, when some of the two thousand locomotives for the Siberian lines will be demanded. All of the forty engines above mentioned are to be of the compound type, with four cylinders on the Vauclain system.

There has arisen in England and here, a very interesting but useless controversy over the part that Professor Forbes had in designing the electrical machinery at Niagara, and it looks very much as if the Professor would have been much the gainer by keeping quiet. It is true he has to fight alone, which is reasonable in as much as, by his account of the matter, he has done the work almost

alone, but in any case such a dispute is undignified, and does not belong in the engineering profession at all. Even Lord Kelvin has been drawn into the battle, and as a London journal remarks, the whole of this Niagara matter, from its inception "furnishes a squalid history." Whatever the final success, the history of the whole will be marred by a theatrical aspect of procedure from the beginning.

The Government engineers appointed to investigate the effect of the Chicago drainage canal on the level of the Great Lakes, have made a report, which is printed in full in the *Engineering News* of Oct. 3rd. It is long, discursive and certainly leans to the opinion that 300,000 cubic feet per minute drawn off would be a great injury to navigation. They also pointed out a new feature in the case, a current that would be set up in Chicago harbor, and say that such a current will result from the contemplated volume of water taken out, 300,000 gallons per minute, or even of a third of this amount, as would not be admissible.

One in reading of coal at the Eastern seaboard, at Norfolk, Va., for example, hauled 400 miles by rail, and delivered at $2.00 per ton on board vessels, stops to think what fixes a price of three times as much here in San Francisco. Four hundred miles by rail is more than it costs to bring coal here by water from Puget Sound and Vancouver. This City and the whole Coast is suffering an imposition by bad management. An evidence of this is seen in the supply for railways, or for "the" railway. The Southern Pacific Company are not fools enough to pay the rates, and do not. We do not know if the Manufacturers' Association have a committee on "coal," if not they should appoint one, a vigorous aggressive one that would not only protest, but act in some way.

The Institution of Civil Engineers, in London, offers prizes for papers on certain subjects, a list of which, sixty-six in number, is given, and among these subjects it is surprising what a large number relate to mechanical or constructive engineering. Among other things is named: Machines for Raising Tailings; Steam Power Equipments for Electric Stations; The Use of Electric Motors in Factories; Electric Lifts and Cranes; Design and Construction of Stamp Mills, and others of the same class. If the term civil engineer applies in England to the same branch of the profession as it does here, these subjects will present much difficulty for the members, as a matter of fact the distinction between civil and mechanical engineers is in England not very clear.

When Senator Villas some years ago pointed out that the rent paid by the Government for postal cars would more than buy the whole of them each year, the Senate promptly voted down a propo-

sition to buy them, and a sum of over two millions a year is being paid for such cars. This, with other leaks of a like nature, is where an annual deficit of eight or nine millions leaks through. The postal service in this country should now return a large revenue instead of being a tax. The mails increase in quantity all the time, and the cost of transporting them grows less, but the deficit keeps up just the same. The Star Route frauds, now almost forgotten, in which the late Secretary of War was charged with having a conspicuous part, showed the wasteful and dishonest methods of the postal service when in the hands of politicians. The detail of the service is good, or at least as good as can be under a "rotative" system, but the head of it needs mending.

Prof. James H. Hyslop, of Columbia College, has been looking into things, and says the need of our times is:

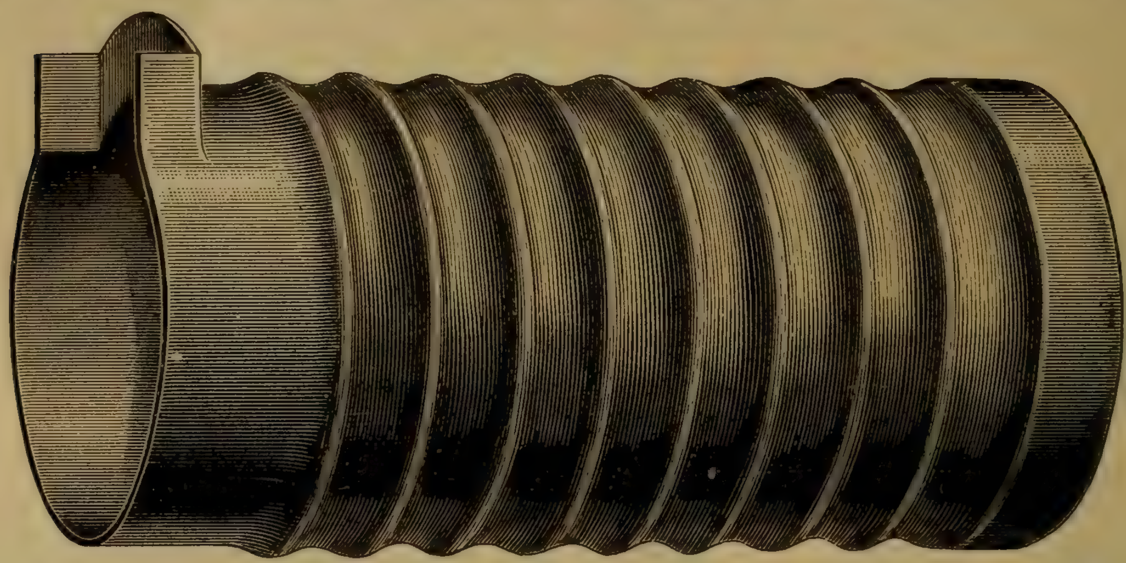
"(1) Freedom of trade, by which all men will be put upon an equal footing in the competition for a share of the world's production; (2) civil-service reform, by which more trustworthy officers can be obtained for the administration of government; (3) improved methods of selecting government officers. At present every demagogue and scoundrel who wants office can play upon the ignorance, passions and prejudices of the laborer, outbid the intelligent and honest man for place, and then enrich himself by robbery and blackmail, the laborer standing by all the while and admiring the politician as his friend. These are political reforms so urgent that nothing can be done for labor until they are effected. All the popular efforts of the day looking to the workman's redemption by increased wages and neglecting the priority of these considerations simply pay out in taxation of some kind what they reap in other ways."

The *Steamship* estimates that in August last 300,000 tons of war shipping was under construction in Great Britain, and that one tenth of this was for foreign governments. The Clyde district, it is claimed, has of the contracted work 60 per cent. of the war ship tonnage, and 40 per cent. of the merchant tonnage now under construction. The advance over the previous two years was for the first nine months of this year 50,000 tons. Shipbuilding in England is an exponent or measure of commercial business. Carrying means trade, and people invest in ships only when there is work for them to do. The same rule applies to this country.

In our political system or plan, the postmasters are appointed, and by custom most of them are turned out and others put in whenever an administration changes, or one of the opposite party is elected. There are 75,000 postmasters, and if one half of them are changed it would require that 31 be appointed every day during the four years of an administration. When there were five millions of

MORISON SUSPENSION FURNACES

FOR LAND AND MARINE BOILERS



Uniform Thickness **Easily Cleaned**

UNEXCELLED FOR STRENGTH

Corrugated Furnaces

SOLE MANUFACTURERS IN THE UNITED STATES

THE CONTINENTAL IRON WORKS

P. O. Station G. BROOKLYN, N. Y.

INCORPORATED 1866

CHARTER PERPETUAL

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

Insures against Damage to Property, Loss of Life, and Personal Injury

CAUSED BY

STEAM BOILER EXPLOSIONS

J. B. PIERCE, Secretary
J. M. ALLEN, President

ABSTRACT OF STATEMENT
JAN. 1, 1895

Cash Capital,	$500,000.00
Total Assets,	1,955,255.24
Surplus as to Policy-Holders,	693,726.15

PACIFIC COAST DEPARTMENT

MANN & WILSON, General Agents

J. B. WARNER, Chief Inspector

306 Sansome Street - San Francisco, Cal.

people in this country, mostly honest, it might have been possible to turn the post office service upside down once in four years, but it is absurd to attempt or permit such a thing with sixty-five millions of people. The duties of a postmaster have nothing to do with the political policy of a country, and the present provincial system is anomalous and discreditable to the Nation.

The Wanamaker dinner in Paris, and the Vanderbilt dinner at Newport, costing together at least $40,000, perhaps a good deal more, are among the signs of the times, an ostentation of wealth, or of money rather, because wealth should mean something more. Such things presage a change in this country. When a Philadelphia shopkeeper, who has built his business on the ruins of hundreds of others, and whose political methods were six years ago the scandal of this country, will spend on his son, an unknown man, $20,000 for a dinner in Paris, it is time that sober-minded people "set a thinkin'," as the Scotch say. This, which is only typical of a hundred more cases of like ostentatious money show, may well be likened to the feasts in Rome before the end came, and the luxury in France that a century ago was the precursor of a revolution. The money spent annually by Americans abroad, mostly for luxury and worse, is estimated at a third as much as our National revenue.

The *Engineering Review* urges a lexicon of engineering nomenclature that will produce uniformity of technical terms, and certainly this would be a relief. As it is now one writes in fear and trembling any matter to be translated into another language. What is to become of "wrench, dog, stack, planer, lumber, builder, donkey, monkey-wrench, track, feed," *et. al.*, if these terms are to be translated by an English dictionary, as is commonly done? Some fun would be lost no doubt, but that we could stand in the interest of good form.

ENGINEERING NOTES.

The old Soho Foundry, of Boulton and Watt, near Birmingham, England, is to be torn down, and the *Engineer*, London, has had drawings made of some of the most notable machine tools in these works, built about 118 years ago. A look at these machine tools, which we have seen in place, makes one think of the joke attributed to Byron about "the ancients stealing our modern ideas." There are in the works drilling, planing and boring machines that could be profitably set at work now in many shops where the equipment is no better, or worse even than at Soho. The horizontal and vertical boring machines are immense implements. The bars in the former are up to 16 inches diameter and 17 feet long. The vertical machine bores 14 feet long and any diameter up to 8 feet or more.

A side planing machine that seems wholly modern in so far as its functions, is 27 feet long, has four saddles or carriages, and a bed 27 × 10 feet. The boring bars and many other larger tools are driven by tangent gearing of a very perfect kind.

There is at last relief from the classic engine lathe that comes along weekly in our Eastern contemporaries as an "improvement." Mr. J. J. McCabe, of New York, has made a revolutionary departure and one that, if we mistake not, will be a success. He has added a second main spindle farther back and above the regular head spindle, so as to do larger work than the lathe will in a regular way receive. This second spindle is well supported, and is geared to the main one behind the face plate. It is an ingenious idea, and will, it is to be hoped, take the place of blocking up lathe heads, an expedient of necessity sometimes, but as bad as can be.

The *Sokol*, a torpedo boat, constructed by Messrs. Yarrow, of London, for the Russian Government, has run at the rate of 32 knots, or nearly 37 miles an hour. This is the greatest speed ever attained on water, and is, as the *Engineer* says, an example of "brute force," but this will no doubt be exceeded some time, when the power is applied to raising as well as propelling such vessels. If the line of force was such as to keep the vessel on an even keel, and the angles of entrance arranged to raise the vessel, the immersed section might almost disappear, and there would be no limitation of speed. The *Sokol* is 190 feet long, 18 feet 6 inches beam.

The new U. S. naval dock at Port Orchard, Washington, now nearing completion, will be the largest of the kind in the country. It is a graving dock to be emptied by centrifugal pumps, three in number having directly attached engines. The pump pipes are 42 inches bore, and the steam cylinders 28 inches diameter by 24 inches stroke. The joint capacity of the pumps is over 100,000 gallons per minute. This machinery, which seems to be of good design, was constructed by Moran Bros. Company, of Seattle, who received the contract, and its execution is certainly a very great credit to engineering skill on the Sound. So is the construction of the dock carried out by Byron Barlow & Co., of Port Orchard. The centrifugal pumps have double inlets with removable side plates large enough to permit the impellers to be placed from the side, the main casing being whole.

It will be remembered by our readers that when the Sprague-Platt system of elevators was announced and published, we ventured the opinion that the design and construction were in violation of well known rules, and that the scheme would not have endurance, also was not "mechanical." The method consists of a set of Arm-

strong pulleys, operated by a screw having a nut filled with steel balls, which from proportions given would sustain pressure beyond the abrading point. Some friends who have been examining the matter at the East confirm this view, and have found that the ball bearings are perishable, just as skilled inference would assign, and that the system is likely to prove a failure. Ball and roller bearings are suitable up to a certain limit of pressure, beyond that they become the most effective of all known means for abrasion. Granite and flint are cut by balls when sand ceases to abrade. Tilghman's chilled shot are simply ball bearings.

The greatest water supply scheme that has ever arisen, is now a subject of consideration in London. It contemplates bringing from the Welsh mountains 415 million gallons a day through two aqueducts 150 miles long, the whole to cost $190,000,000. There has always been a water want in London. The growth of the immense city and the increased consumption in proportion to population has pressed upon the resources of the various companies that supply water. There is no lack of it in the country but its purity is a difficulty.

An inventor in New York proposes to propel vessels by discharging charges of air and gas astern, by a tube or cylinder open to the water at its outer end. We take an interest in this new invention, as one less impractical than jet propulsion, which is faint admission. The inner end of the tube should be filled with a yielding piston that would slide back with the explosion of the charge, and then return by springs to its starting point. This far we see the way clear to direct impulsion, but will the water remain in the tube or run in after each charge? Also will an automatic inlet valve permit the water to enter the tube behind the piston? If the inventor intends to fire the gases out against free water at the stern we will have nothing to do with his scheme. The whole matter is set forth in the New York *Tribune*, which from its name should be a high authority in this and all other matters.

The Underground Central Railway in London is now a tangible scheme. The capital is about $15,000,000, and the whole of this stock has been taken. The borrowing power is limited to about 33 per cent. As an engineering scheme it is unique and bold. There is a double subway, from 40 to 80 feet below the surface of the streets, reached by vertical elevators at fourteen stations, the whole length of the line being 6½ miles, to be run over in 25 minutes by trains to hold 336 passengers. The subways, except at stations, will be 11 feet 6 inches in diameter, and at the stations twice this diameter. The lines will be 36 feet apart. The estimated traffic is seven millions of passengers per mile, or forty-five millions a year. The engineers are Sir Benjamin Baker, Sir John Fowler and

Mr. Greathead, inventor of the tunnelling shield that bears his name, and who has the widest experience in "burrowing" of any engineer now living. The facts here given are taken from the *Railway World.*

Next to a locomotive engine running 60 miles an hour, at a rate of 300 revolutions per minute shaking about on a yielding frame, jerked, jarred, covered with grit and inaccessible, is the feat of a marine engine going 16,000 miles incessantly. Steamers often go out from England to Australia without a stop. The steamer *Wooloomooloo* ran last Spring from England via Adelaide to Sydney, Australia, 42 days without a stop. The speed was 11.5 knots throughout, but in this case the "name" of the steamer may have had something to do with the matter.

Almost the first electric railway in Europe, and the first in the United Kingdom, was from Newry to Besbrook, in Ireland, driven by water power. The line as we remember, is seven miles long, and now the first mountain electric railway is on the Isle of Man, a little principality in the English Channel, that has a government of its own, and a particularly good one too. The railway starts at Laxey, where the great water wheel is, and goes up 2,000 feet to the top of Snaefell Mountain. The line has been examined by the British and home governments, and pronounced safe for traffic.

The "lightning ship" designer has been quiet for some time. He comes around with tolerable regularity since the Winans in 1860, or thereabout, built their "cigar steamer" at Baltimore. Mr. Feyer, at Alexandria, Va., brings up the rear with a vessel 222 feet long and 16 feet beam to have a pendulous stability like a modern yacht, and go through the water like a knife, irrespective of the rough surface and at some speed comparable to a smart railway train. There are more to come yet no doubt.

Some experiments have been made recently, with steam heated up to 800 degrees, in an engine specially designed for the purpose in Germany, compound and condensing, consuming only 10.17 pounds of steam. The engine was regularly operated with steam superheated to 700 degrees, and it is claimed that no difficulty occurred from the high temperature. An engine of the kind has been procured for experiments at the Sheffield School, in England, and we may expect to hear more of it in future.

The problem of tapering chimney flues is now in order for solution, with a strong chance that a parallel flue is as good as any other, no doubt is better. The reasons in favor of the large end up or down are obscure, and the question reminds one of the "choke-

bore" guns. This myth has lasted for a century, and is firmly believed by nine tenths of the people, that is, that the scattering of a shot gun could be controlled by contracting the bore at the muzzle. Perhaps it can, but we invested in a tolerably careful experiment by boring a gun in various ways, and found a parallel bore by far the best. The choke bore was worse than a flaring one, just as logical inference would point out. Jamming the shot together just as it leaves the gun is not likely to prevent scattering, but people think so. We have also built chimneys each way, and think a parallel bore for chimneys and guns, if not the best, as good as any other form.

We have at various times for five years past called attention to the progress of hydraulic power distribution in other cities, and the peculiar circumstances that favor such a system in San Francisco. It is true that within this time the electric system has come into use, and in a great degree supplies the want of power distribution, and is for most purposes less expensive than hydraulic power as it has heretofore been supplied, still there seems to be a profitable margin left for a plant, such as those in London, Hull, Birmingham, Glasgow, Antwerp and Sydney. The intensity of the power in the mains enables direct application to various useful purposes, and with an economy that is phenomenal. In London the average efficiency over a period of nine years was 92 per cent., and in Liverpool for six years down to 1894 was 95 per cent. The pressures employed are from 700 to 750 pounds per inch, except in Manchester and Glasgow, where the pressure is 1,120 pounds per inch. The length of main pipes now in use exceeds 150 miles. The number of machines operated is 3,671, mostly those with rectilinear motion, but in some cases, especially in Antwerp, a good many small turbines are operated with very high efficiency.

The battle of the marine boilers is again raging, and the cylindrical type seems to have the best of it. The *Ohio*, one of the old Philadelphia-American line, now belonging to the Wilson line, of Hull, England, was fitted up with Bellville boilers, and has made a lame showing on two trips out to New York. Mr. James Howden, of Glasgow, in a letter to *Engineering* says that mishaps to the boilers took place before the ship left the Irish coast, and her rate to New York was only seven knots an hour, and that on her second trip the boilers gave out before she got into port. A call had to be made at Dover for repairs, and a tug boat was sent out from Hull to convey the ship to her port. This is decidedly bad, and as the boilers were furnished by the celebrated firm of Maudsley Sons & Field, the makers in England of the Bellville boilers, there is room for explanation. Mr. Howden is a fierce antagonist of the water-tube system for marine purposes.

ELECTRICITY.

The Snaefell Mountain electric railway, in the Isle of Man, has no "trolleys," but instead a plain cross bar on which the line wire slides. It looks all right, is extremely simple and there is no wear that need be considered. Mr. T. Carter, a civil engineer, at a late meeting of the British Association said he considered it a much better plan than trolley pulleys, because there was no danger of losing contact by the trolleys coming off. It is pretty hard to see what a running contact is for, and it may be that a sliding contact is better, in many cases certainly is more simple and direct. A circle meeting a plane gives only point contact.

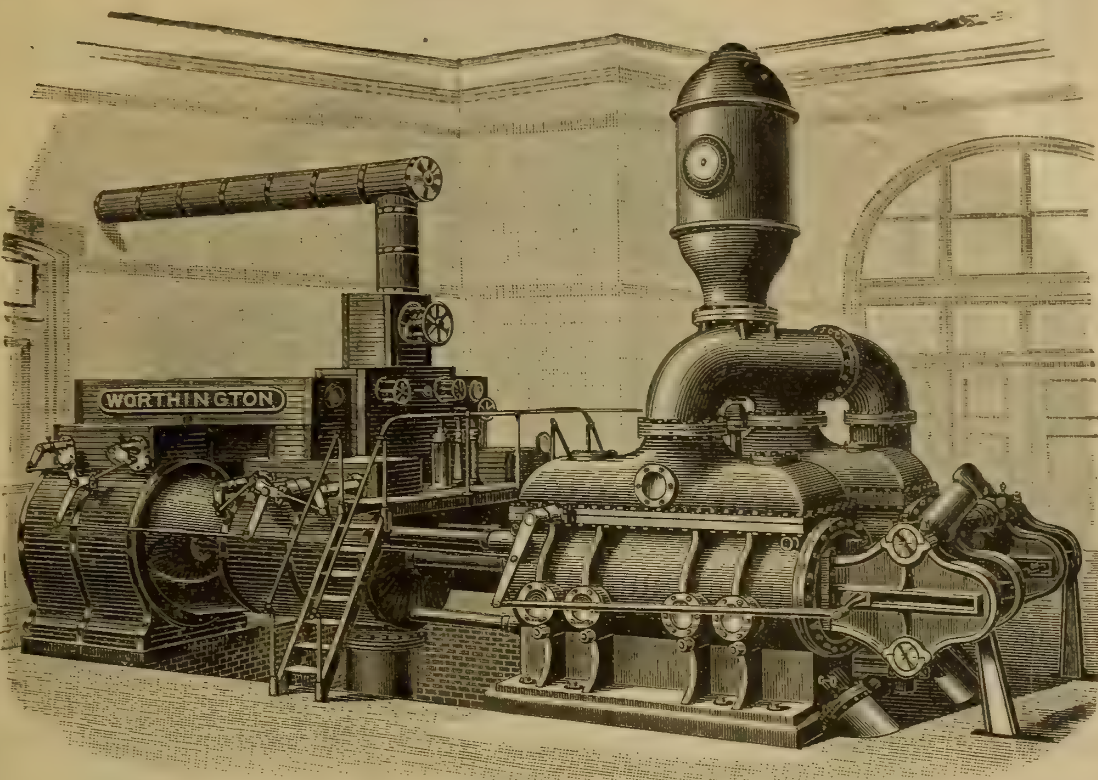
The Westinghouse Electric Company are reported as making experiments in propelling street railway cars by a system wherein the current is taken from a conductor beneath, a long bar under the car passing over and maintaining contact with points that are energized from a main conductor as the car passes, and then becomes neutral or non-electric. The idea is not new, but the method is, no doubt, and as the Westinghouse Company usually "hangs on" when they take up a new thing, there will most likely be more heard of this matter in future.

A French company is to provide from water 3,000 horse power, and send the current into the City of Mexico within 30 months, to be supplied constantly at 736 volts, and are to be paid at the rate of $300 a year for each horse power. The contractors have to deposit $20,000 worth of Mexican bonds as a guarantee, to be returned when the 3,000 horse power is prepared and delivered. The power will be obtained from the River Necaxa, in the State of Pueblo, and is to be increased in five years to 8,000 horse power.

The "Waterman's Arms," a public house in London, owned or operated by Messrs. Meux & Co., brewers, has been shaken by some high speed piston engines, in an electric station near by, and as the "watermen" did not want their beer spilled or their pipes shaken in the tap room, the engines had to come out, being suppressed by an order of the Court. Parson's steam turbines were substituted. Now it remains to be seen if the humming noise does not cause annoyance to the "watermen," calling out a new injunction. On the whole we like this. It is the assertion of personal rights. Where this is written we have to get into sychronism with a neighboring gas engine that communicates its rythmic oscillations to the building, but if it came through the wall, and climbed on over our desk, there would be no remedy at law. We do not mind it so long as the engine is so regular as to not spill the ink.

WORTHINGTON HIGH DUTY PUMPING ENGINES

THESE HIGH DUTY PUMPING ENGINES Have been adopted by the World's Fair Commission to supply all buildings and grounds of Columbian Exposition, Chicago 1893.



THE CONTRACT CAPACITY of **Worthington Pumping Engines** for Water Works alone to Jan. 1, 1892, **2,585,000,000** Gallons daily, which would afford a stream of water 12 hours per day, 400 feet wide, 5 feet deep, with a current 3.4 miles per hour.

Pumps for all purposes and for any pressure to 8,000 pounds per square inch. The pumps in the Mills Building, Crocker Building, Chronicle Building, Donohue Building, Union Foundry Block, First National Bank Building, Telephone Building, Lick House, Occidental Hotel, and many others in San Francisco, are Worthington.

A. L. FISH, AGENT, 59 AND 61 FIRST ST., S. F.

ALSO AGENT FOR THE

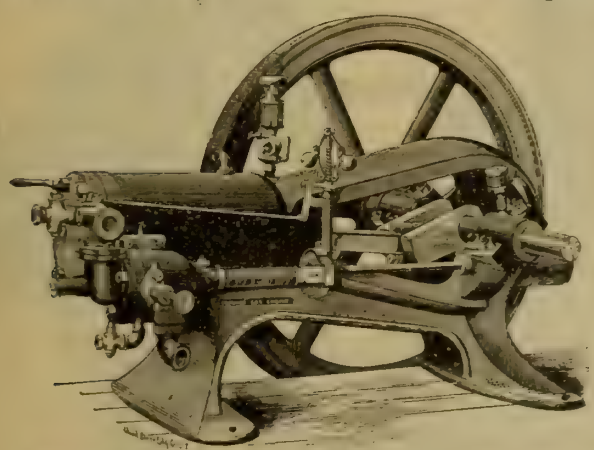
AMERICAN FIRE ENGINE Co., which includes Clapp & Jones, Silsby, Ahrens & Button Engines

BUCKEYE AUTOMATIC CUT-OFF ENGINES, of Salem, Ohio

CURTIS' STEAM AND WATER PRESSURE REGULATORS

NATIONAL WATER PURIFYING CO.'S FILTERS

Perkins Gas, Gasoline or Oil Engine



Modern, Economical, Reliable in all Situations Requiring Small Power. These engines lead in Simplicity and Low Prices. Send for Engine and Pump Catalogues.

PERKINS PUMP & ENGINE COMPANY

PAUL B. PERKINS, Manager.

117 Main Street, San Francisco.

P. F. CLERC, MACHINE WORKS

Manufacturer of the Best Steam Puffing Irons

Sole M'f't'r L. P. GARCIN'S LIFTING JACKS

LAUNDRY MACHINERY A SPECIALTY.

219 and 221 Main Street, S. F., Cal.

Having been established since 1861, I refer to all the leading laundries of California. REFERENCES: San Francisco Laundry; La Grande Laundry; America of Sacramento; Occidental Laundry; United States Laundry; Contra Costa Laundry.

SCHOOL OF

Practical, Civil, Mechanical, Electrical and Mining

ENGINEERING

Surveying, Architecture, Drawing and Assaying.

OPEN ALL THE YEAR **723 MARKET ST., S. F., CAL.**

A. VAN DER NAILLEN, President.

Assaying of Ores, $25; Bullion and Chlorination Assay, $25; Blowpipe Assay, $10; Full Course of Assaying, $50. Established 1864. Send for Circular.

MINING.

NOTES.

The mining people of Washington, like those of California, are becoming incensed over the patenting of mineral lands to railway companies, contrary to the intent and meaning of the Acts of Congress ceding bonus lands, and have engaged in a vigorous protest from Snohomish County. As mineral lands are not apt to be agricultural, and the reverse, there is no doubt the railways have the minerals in view, and if once in possession, they are not likely to respect mining claims, unless in their own interest.

A mining boom in Corea would be a desirable circumstance at this time and is possible, if there are no impediments presented by the Government of that country or by Japan, which influences if it does not control that peninsular kingdom. Some American mining engineers have been sent out there to investigate the mining possibilities of the country. Mr. Clarence Greathouse, formerly of this City, now an adviser of the King of Corea, is said to be the instigator of the commission, and this is quite probable.

The speed at which mine hoisting is done has been the subject of various communications to this department of "INDUSTRY," the rate rising continually. The following letter has been received from Mr. Robert Stevenson, C. E., of this City:

" With respect to hoisting speed I was surprised to see an article in the *Mining and Scientific Press* a short time ago which stated that English engineers in the Transvaal would have to come to this Coast to learn something about high speeds, and in "INDUSTRY" you think 3,000 feet per minute is terrific. Now allow me to tell the *Press* and yourself that such speed is a normal speed in all the first-class coal mines in England, and has been for thirty years. I have often been dropped down by machinery 1,500 feet in less than half a minute, and when you consider the starting and stopping, some of the speeds must have exceeded 4,000 feet per minute. It is the start which gives the sensation, when your jacket flies over your head, and your heart for an instant closes the windpipe. After the first second you do not know whether you are going up or down until the stopping begins, then you feel as if you weighed about a ton weight.

" In one of the mines I had charge of in Staffordshire, twenty years ago, we hoisted the water instead of pumping it, and I have often timed the tanks, which required about three fourths of a minute each to make a complete trip, the depth was 1,200 feet, and the tank held two tons of water, and as there were two tanks, one going

down when the other was coming up, the output of water was $5\frac{1}{3}$ tons per minute, and when you reckon one half a minute for filling and discharging the average hoisting speed would be about 4,800 feet per minute, so you see it is not necessary for English engineers to come here to learn fast hoisting, because there is no machinery made on this Coast that will compete in speed and economy with that made in Lancashire, England."

ROBERT STEVENSON.

San Francisco, September, 1895.

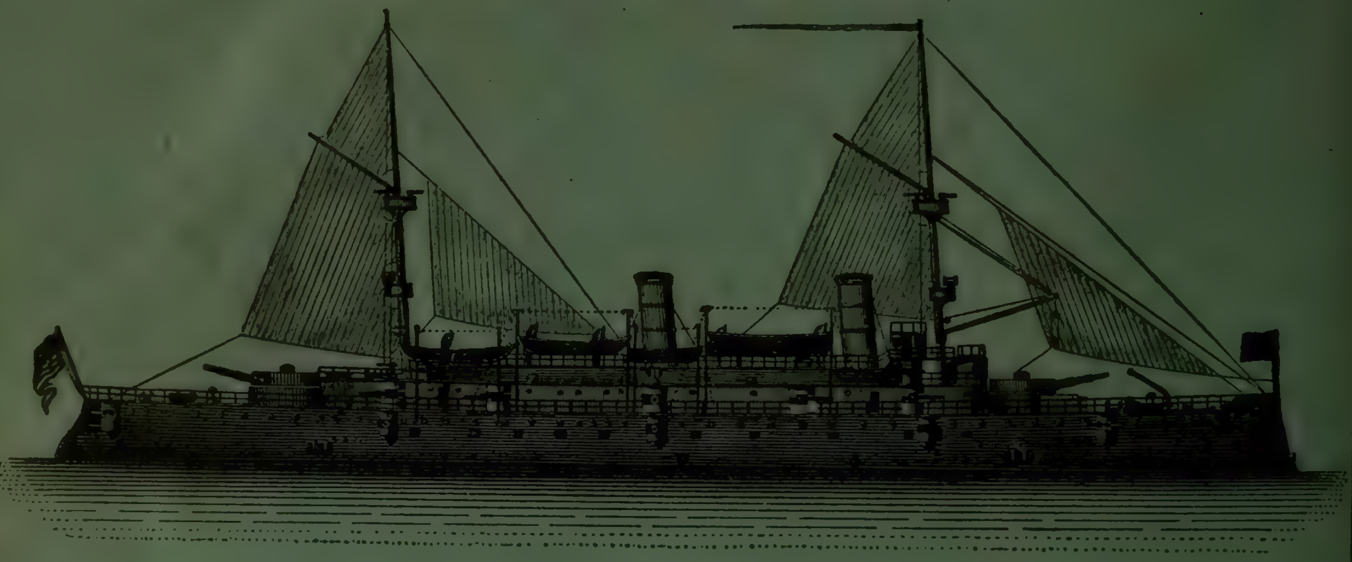
The division of the great Anaconda mining property at Butte, Montana, and sale of a portion of the shares abroad, is, possibly, a scheme for repeating with better success the Secretan venture of four years ago, and controlling the copper product of the world. If so a second failure will be deserved. International combinations are a kind of robbery, especially in such a thing as copper, which among all metals enters most widely into the useful and necessary arts. We have never had a third as much copper as is needed, and its use is confined only by its cost. It is the non-corrosive element in structural work, the foundation of industrial alloys. There was no need of selling Anaconda shares in Europe, unless some kind of coöperation there is intended.

The Mexican Government has a hard time trying to figure out that the new "extraction tax" of five per cent. on minerals is not an export tariff, but a revenue tax. The "name" will not much matter to American investors in Mexican mine property, and reminds one of the grammar involved in an order for the execution of a man in the south, where a chief officer objected to the word "hung," claiming it should read "hanged," a question in which the man himself took no interest. The preamble of the new law reads as follows:

"Besides the duties fixed by Articles 4, 5 and 6 of the decree of June 6, 1887, silver and gold will pay to the federation the taxes of coinage, stamps, refining, smelting, assay and parting in accordance with the following bases:"

Section VII reads:

"(7) Ores of gold and silver which are exported in their natural state, or only mechanically concentrated, shall pay the taxes of coinage and stamps on the value of the gold and silver contained after deducting 10 per cent. of the contents."



No. 89. DECEMBER, 1895. Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor Founded 1888. W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

WASHBURN & MOEN M'F'G. CO.

WORKS:

WORCESTER, MASS. WAUKEGAN, ILL. SAN FRANCISCO, CAL.

For Mines, Logging Camps, Ships' Rigging, Street Railways, and All Purposes.

SAN FRANCISCO OFFICE:
8 and 10 Pine Street.

PACIFIC WORKS:
Bay and Powell Sts.

FRANK L. BROWN, Pacific Coast Agent.

14 in x 6 ft. HENDEY-NORTON LATHE with IMPROVED AUTOMATIC STOP.

This Lathe **COMBINES** the **LATEST** and **BEST** Improvements. Automatic Stop. It is simple, durable indispensable. It will **Automatically Stop** the carriage in **Either Direction.** It is equally efficient whether **Feeding or Thread Cutting.** Running up to a shoulder, boring to **BOTTOM** of holes, or **INTERNAL THREAD-CUTTING.** No danger of spoiling either tool or work. It is a safeguard against accidents in either direction. **FEEDS.**——It has all feeds in daily use with simple movement of lever. **THREADS.**——It has all threads in daily use with simple movement of lever. **CARRIAGE.**——The Carriage reverses in Apron. No slamming of Countershaft. There is no Comparison between this Lathe and the old style or common lathe. Quick work, rapid changes, satisfactory results. Buy the best. Send for Circular.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. DECEMBER, 1895. No. 89

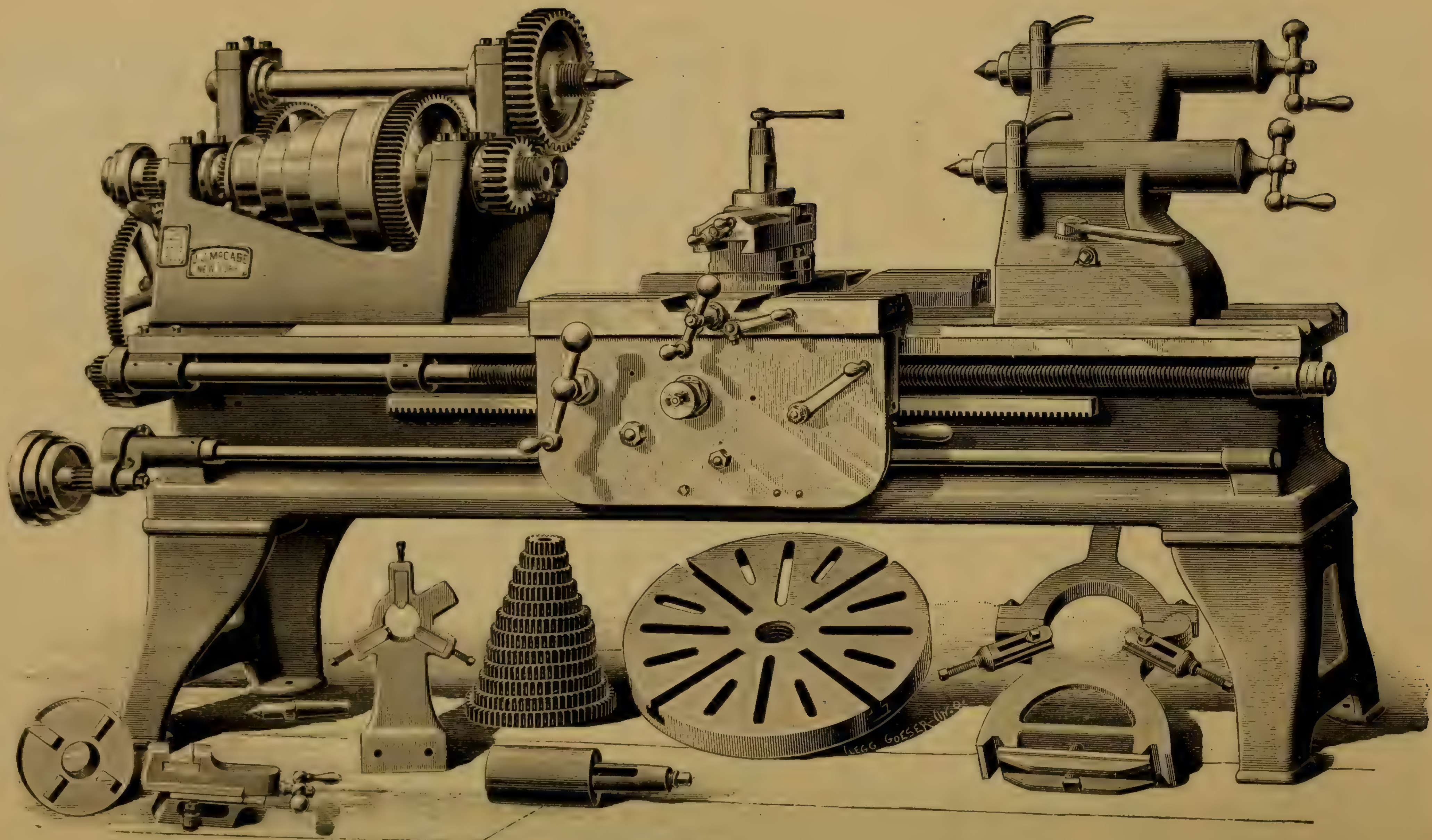
COMPOUND ENGINE LATHE, 24 AND 38 INCH.

J. J. McCABE, NEW YORK.

Last month we had mention of the invention and introduction of what may be called compound engine lathes, shown in the fine drawing on the following page. These lathes, as will be seen, have two sets of spindles, one for special work of much larger diameter than the rated or normal capacity, affording in much better form the advantages of that awkward type called "gap lathes," which have happily never made much way in this country.

To meet the objection, and the only one we can think of, to the compound arrangement shown, that lathes should not be employed for work beyond their rated capacity, there is this answer. Lathes are so employed continually, and properly too in very many cases, and this is attained by blocking up the heads, not only by the users, but frequently by the makers. This is a very imperfect expedient when compared with an auxiliary triple-geared spindle set in such a position as will keep the turning strains within the proper plane over the main frame, and calling for no change of the feed or train-wheel connections.

In a fully-equipped works there are tools adapted for all kinds of duty, and no requirement for other than the standard types of implements, but for one such case there are several that lack such facilities. In repair shops for factories and mines, on steamers and in country places, it is impossible to keep a lathe at work within its rated capacity unless it be much too large for the average work, and



Compound Engine Lathe, 24 and 38 Inch.—J. J. McCabe, New York.

the compound spindle expedient seems to best meet these circumstances, that is, accomplishes the work with the least expense and in the best manner.

As a matter of fact there is no direct adaptation of engine lathes. Take, for example, a lathe of 24 inches swing, the most of its working time is spent on pieces of less than six inches diameter, and the full swing is at best an emergency use. The natural division would be different lathes for long and short work, that is, for shafts, rods, screws, studs, etc., and a different class for pulleys, wheels and the like, of large diameter, so a compound lathe like the present one has equal claims in the way of adaptation.

The upper spindle, as will be seen, is triple geared, the last mover driving on the face plate, so its rigidity is quite equal to the lower one, and its position is better for all kinds of exterior turning, in fact it is in the position that the lower one should have for all kinds of turning, that is, set over the rear side of the frame.

The only alterations required in changing from one spindle to the other is to place and remove the intermediate pinion between the spindles and change the face plate and tool supports. These latter we think should have a wider base on the carriage than is indicated in the drawing, and have proportions intermediate to the two spindles, which may, however, be the case in practice.

We are becoming tired of the stereotyped engine lathes, and must congratulate the makers of this one for having at least "got out of the rut." We do not complain of quality, or even of performance, with standard lathes, but when an implement applied to so many diverse purposes is made without discernable difference in design it certainly indicates a want of the best adaptation.

SHIPPING CHARGES AT SAN FRANCISCO.

The meeting called by the Ship Owners' Association on the 8th of last month will do a great deal of good in one way. It will bring some notice to the fact that shipping is grievously and illogically taxed at this port. The circumstances of shipping are a mystery to the public. We have experimented a good deal in loaning out among friends copies of "Wells' Merchant Marine," and in most all cases the facts therein set forth were new and a matter of amazement to the readers.

At the meeting above mentioned a good deal of animus was

shown against "compulsory pilotage," which shows that the subject is a new one. There is no difference between paying pilotage when there is no pilot on board, and paying too much pilotage when there is one on board. The whole thing is an excessive tax on shipping, and may be more equitably assessed under the half pilotage rule than otherwise. This is not the issue at all. What we want is free pilotage, without patronage or regulation by the State. If there is to be regulation at all it should be by the underwriters, and pilots be hired as the masters, mates and engineers are.

Forty years ago a similar close corporation of pilots proved one of the potent causes of destroying the steamboat interests on the Mississippi River. They had a complete organization, shielded by government license. There were grips, signs and pass words; a fund for "incapables," and wages up to $300 and $400 per month for a service that if free, was not worth one third this much. It all ended thoroughly in good time.

Pilotage is but one of the onerous charges on shipping at this port. Taxation as shore property and port charges are even worse. Mr. Dickie pointed out in his address that the amount of taxes assessed against shipping here is *twelve times* as much as is paid by the great trans-Atlantic lines, quoting from a recent report by the United States Commissioner of Navigation. Railways that are internal, and enjoy the benefits and privileges resulting from taxation, do not contribute in proportion to ships. They are not licensed, examined and harassed by regulations. They have no licensed officers to manage their trains, but railway men make laws and mariners do not.

Under some sentiment, not easy to explain, people seem impressed with a kind of buccaneering spirit that wants to pounce upon every ship that enters the port and exact a suicidal tribute that must ultimately be paid in double fold by the losses to local commerce and industry.

We have so many times commented on this matter, giving facts, statistics and comparisons, that it would be a repetition to go over it again. The Hon. Eugene T. Chamberlain, U. S. Commissioner of Navigation, has done more during his term to explain the restrictions on American shipping than his predecessors had done for twenty years before, and this very service may, we fear, become a cause for his removal. The antiquated navigation laws of this country exist because they are unknown in a public way, and anything that promotes inquiry is in the direct line of reform.

Continued from page 662.

THE MODERN GAS ENGINE.*

BY G. E. STEVENSON.

DOUBLE CYLINDERS AND DOUBLE ACTION.

"The construction of double-cylinder engines has been a source of some diversity in form. Messrs. Crossley Brothers first commenced in 1890 to make pair cylinder engines, with double cranks placed at an angle of 180 deg. to one another. The cycles in the two cylinders being alternate, an impulse was obtained at each revolution, first in one and then in the other cylinder. This plan has now been relinquished in favor of placing the cylinders with the pistons facing one another, and working on one crank. In this form there is less strain on the crank shaft, but the impulses are not so equally divided, inasmuch as two working revolutions follow one another, and are followed by two negative revolutions. Messrs. Andrews & Co., in their latest large engine, adopted the tandem form. The cylinders are placed one behind the other, the piston of the hindermost cylinder working, by means of crossheads and coupling rods, on the same crank as that of the forward cylinder. The cycles are alternate, and an impulse is obtained at each revolution from one or the other cylinder. This engine is 400 horse power effective (200 to each cylinder). It was made for Messrs. Henry Spicer and Sons, and is erected at their paper mills at Godalming.

"It has been stated that the recent developm[illegible] of the gas engine is an approximation to one standard type. Whils[illegible] this is so in the main, there are some singular exceptions. The double-acting engine of Messrs. Dick, Kerr & Co. is an attempt to reduce the form of the gas engine to that of the steam engine. In this engine the cylinder is closed at both ends and has a pi[illegible]on rod, in all respects similar to that of a steam engine, working through a stuffing box in the front cylinder cover. The engine works on the Otto cycle at both ends of the cylinder, and its action is identical in effect with that of the end-to-end double-cylinder engine of Messrs. Crossley Brothers. Messrs. Scott Brothers, of Halifax, are the makers of what is called the Duplex Otto engine. This engine has two pistons working in opposite directions in one cylinder, under one and the same impulse. The back piston acts by two side connecting rods, on cranks placed at 180 deg. with that of the forward piston.

*Paper read before the Incorporated Institution of Gas Engineers, London.

"So far as the author is aware, no compound engine has yet been made in this country, but Professor Aimé Witz, in his latest volume on the gas engine, describes one invented in America, bearing the name of Connelly, in which it is attempted to embody this principle. In this engine two cylinders of different dimensions are employed, and, whilst the explosion takes place in the smaller cylinder, the expansion of the products is completed in the larger cylinder.

USE AND COST.

"The purposes for which gas engines are used are becoming rapidly more extended and various. Machinery of all kinds is now driven successfully with them, and their application for electric lighting purposes is becoming an important consideration, especially for taking up the day load in central stations. At the Blackpool Tower, gas engines to the extent of 500 horse power effective are used for electric lighting, and at the new Midland Railway Station, Leicester, gas engines, in the aggregate of 300 horse power, have been put down for the same purpose. Gas engines are used at the Birmingham Waterworks for pumping purposes, and Messrs. Crossley have now on hand for the River Wear Commissioners a set of three high-speed engines, each of 120 horse power effective, for driving centrifugal pumps, to which they will be coupled direct. A similar set of engines is being made by Messrs. Tangye for the same purpose.

"Gas engines have already been tried in this country for driving tramway locomotives, and on the Continent there are several instances where they are successfully applied for this purpose. They have also been used for propelling boats, and a company has been formed at Havre to work boats on the Seine with gas engines, the fuel being ordinary town gas compressed in cylinders. The number of gas engines actually in use at the present day is hardly to be realized, unless special attention is given to the subject. Messrs. Crossley have turned out 24,400 Otto engines, Messrs. Andrews give 7,000 as the number they have made, whilst the German Otto Company have made some 8,000.

"At the present day there are some dozen or more makers of Otto engines in this country alone. In Manchester there were, at the close of the last financial year, 966 gas engines on the books of the Gas Department, and the consumption due to these in the year was 123,000,000 cubic feet of gas.

"So far as the smaller engines are concerned, every addition to

the purposes for which stationary gas motors are used, means an increase in the business of the gas manufacturer, but under present conditions this is not so with regard to large engines. So long as gas is sold in our towns at the usual lighting rates, large engines will be more cheaply worked with Dowson gas. Messrs. Crossley state that it costs them 2½d. per thousand cubic feet to make Dowson gas, and they require to use five times as much of it as of Manchester city gas to produce an equal horse power effect. According to this, it would be necessary to sell town gas at 1s. 0½d. in order to compete with Dowson gas; but inasmuch as other advantages ensue from using gas of high calorific value, such as reduced size of engine and less cost for attendance and wear and tear, the author believes at a price of 1s. 6d. per thousand cubic feet town gas would be used in preference to Dowson gas. He is supported in this opinion by the fact that at Sunderland, where gas is supplied very cheaply in large quantities, many high-power engines at the docks and elsewhere are working with town gas.

"At the engineering works of Mr. John Dickenson in that town, ten gas engines, with an aggregate of 400 horse power effective, are supplied with town gas at 1s. 6d. per thousand cubic feet, and the proprietor states that there is a considerable saving over the use of the steam engines which he formerly employed. At Messrs. Andrews' works, at Stockport, a gas engine of 100 horse power indicated drives the workshop machinery. It is fed with Dowson gas, and can develop 67 brake horse power, but its present load does not exceed 40 horse power. The Dowson producer consumes 26 to 28 cwts. of Welsh anthracite coal, at 22s. 6d. per ton delivered, per week of 60 working hours. Taking the mean consumption at 27 cwts., the consumption per horse power per hour works out at 1.26 lb.

"The cost of working this engine will be as follows:

27 cwts. of coal	£1	15	4½
Attendant for producer	1	5	0
	£3	0	4½

"If fed with town gas the consumption would be 20 cubic feet per horse power per hour, or 48,000 cubic feet for the 60 hours. At 1s. 6d. per thousand cubic feet the cost would be £3 12s. per week. No attendance would be chargeable, as the engine, once started, will work on all day with occassional inspection in connection with the water circulation and oil feeds. The difference of 11s. 7½d. per

week (or less than £30 per annum) is certainly not too much to allow for repairs to, and interest on, the Dowson plant. If instead of this unnecessarily large engine one of 40 horse power were employed, with a gas consumption of 16½ cubic feet per horse power, the fuel consumption would not exceed 40,000 cubic feet per week, costing, at 1s. 6d. per thousand cubic feet, £3, or below the cost of working the Dowson plant." * * * * *

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Society held its regular monthly meeting on the first day of November. Prof. F. Soulé, of the University of California, presented and read a paper on "Tests of Pacific Coast Timber," made up from experiments conducted in the laboratory of the University, that included crushing, breaking and shearing resistance of various varieties of native timber. The manuscript not having been deposited with the Secretary at this time, being held for revision by the author, we are unable to give the usual synopsis.

Messrs. W. W. Waggoner, Mining Engineer; W. F. Englebright, Civil Engineer, and Dana Harrison, Mining Engineer, all of Nevada City, Cal., were elected members of the Society, and one proposition for membership was received. As the forms in this section of the magazine are made up by the 20th of each month, we are frequently unable, as in the present case, to announce the paper for the following meeting.

The Technical Society of the Pacific Coast is one of wide possibilities, both in constitution and environment. It occupies an inconspicuous place, however, for reasons that grow out of its nature and objects. These were happily and correctly set forth in President Dickie's address printed in our last issue. The cold realm of demonstratable and computable facts, the gauge of utility, it may be called, shuts out the sentiments and policy that appeal to notice and external influence. Papers of great interest are coldly received if the propositions cannot be presented in the form of an equation.

We are not finding fault with this. It is commendable and honest, besides, and most important of all, it harmonizes with the views and preference of nearly all the members, who neither care for nor seek for popularity or name beyond their association, but the popular acceptance of the Technical Society is a point to which we intend to devote some attention in our next issue.

Continued from page 577.

MACHINES AND PROCESSES.

THEIR NATURE AND ECONOMY.

BY J. RICHARDS.

CHAPTER III.

IMPULSE STEAM ENGINES.*

As the subject is to occupy considerable space here, before entering upon impulse or turbine steam engines directly, it will be best to consider in a general way some of the principles that govern the action of prime motors of the class in which these engines belong.

This will constitute in some sense a digression, but the explanations given will apply to other motive engines and machines of the same class, and afford the advantage of an earlier discussion of the impulse types of engines and motors, a subject which should at this time engage the earnest attention of all engineers and mechanics.

No other new kind of engine or motor has come forward at such an astonishing rate of progress, and no change in steam engineering during the present century can compare with the far-reaching possibilities of the impulse engine or "steam turbine" as indications promise at this time.

As prime movers are impelled by the movement and pressure of fluids, elastic or non-elastic, the study of such motors or engines in so far as their actuating energy becomes a problem of fluid action, so we may consider from the same premises most of the features pertaining to all motive engines impelled by water, steam, gas or air.

There is, however, as has been already pointed out to some extent, a natural division of these engines or motors into two distinct types; one acting by the pressure, and the other by the impulse of fluids. In the first class are all engines that receive direct pressure from confined fluids, as in all kinds of piston engines operated by steam, water, air or gas, including that class of water wheels and engines operating by maintained or constant pressure.

In the impulse class of motors the impelling fluid is discharged against surfaces open and not confined, the momentum or spouting force impinging against the actuating surfaces, commonly called

*The term "impulse" is applied to these engines for want of one more relevant. It implies blows, or a succession of applications, which do not exist in engines or water wheels unless the succession of vanes or buckets is considered.

vanes or buckets, the effect being theoretically equal to the gravity of the fluid by its head or pressure, less the friction of discharge orifices, friction on the surfaces of the vanes and some other losses that will be noticed farther on. This type of motors includes the Girard and tangential, with some other kinds of water wheels, also steam or air turbines and wind wheels.

Pertaining to all these engines or prime motors there are certain principles or conditions that should be kept in mind because greatly aiding a logical understanding of their nature and functions. One of these conditions especially affecting impulse or turbine steam engines, and all engines impelled by elastic fluids, is that their size or weight and dimensions are approximately as the area of the actuating surfaces, and is inversely as the velocity at which these surfaces move.

Another condition is that the rate of piston movement is a direct factor in computing the horse power of piston engines, and the limitations in this direction are mechanical, as has already been explained, so that for a short rule we may say that the size of an engine of any kind is inversely as its speed.

A third condition, not quite so plain, is that the speed of engines operating by pressure can be regulated or adapted to suit various purposes without loss of the impelling fluid. In other words, the amount of fluid consumed, omitting its expansion, is measured by the velocity, or the distance which the actuating surfaces move, because the fluid is confined and measured off, so to speak, in proportion to duty.

This is not the case with impulse engines or motors. These have a determined speed based on the rate of efflux or flow of the impelling fluid, whether it be elastic or inelastic, this rate being, when the fluid is applied in a proper manner, from 50 to 55 per cent. of the velocity of efflux. The reason that the rate of movement cannot be varied in impulse motors is that the fluid not being confined is free to escape whether the motor is running or not. A wind wheel, which belongs in this class, is a good illustration. The wind currents pass whether the wheel be in motion or still.

This rule in respect to speed applies to all kinds of engines and motors for air, water or steam, and for purposes here it will be assumed that the working rate for the actuating surfaces is one half that of the flow, or, as it is called in the case of water, the "spouting velocity." The term "flow" will be employed in future for fluids of all kinds.

With this much in a preliminary way, we will now proceed to consider the features and functions of impulse steam engines.

It has been mentioned that the velocity of surfaces impelled by the impact of fluids should move at one half that of the flow or efflux. The reason is that in order to utilize the full force of a jet of steam, or other fluid in motion, it should be brought to a state of rest, that is, its energy should be wholly exhausted. To accomplish this, the vanes, or buckets as they are sometimes called, of impulse motors, are so formed as to "reverse" the course of the impinging jets. The fluid is discharged into one side of a curve, which it follows around so as to change and reverse the course.

If a wheel or engine is standing still, and a jet of fluid is projected against its curved vanes, the fluid would be thrown backward with a force dependent on the smoothness of the curve, and the correctness of its shape, and this backward discharge would represent wasted energy. If, however, the vanes are moving with the fluid, at half its velocity, and the course is reversed by the form of the vanes, the resultant of the two motions will cause the fluid to leave the vanes in a state of rest. In other words, the components of the wheel's velocity and the reversed velocity of the jet produce complete rest of the fluid.

To state this another way, the spouting fluid is arrested gradually or elastically, we may say, and is then dropped when its total energy has been exhausted. This is not an easy matter to make plain by words, but is easy to demonstrate by diagrams, showing the various forces, and the fact is, as before stated, that all kinds of motors impelled by the impact of either elastic or inelastic gases should move at from 50 to 55 per cent. of the velocity of the impelling fluid. Assuming the flow of steam to be 1,000 feet per second, or 60,000 feet per minute, and dividing this by 2 we have for the velocity of the vanes of an impulse steam engine, 30,000 feet per minute.

Comparing with piston or pressure engines, and assuming the piston velocity of these to be 800 feet per minute, which is far above an average, we have the astonishing difference of 37·5 to 1. Recalling a former proposition, that the general dimensions of a motor impelled by a fluid are directly as the pressure, and inversely as the velocity of the actuating surfaces, the difference in dimensions will by this rule be as 37·5 to 1. This is the most remarkable feature of impulse engines when they are compared with pressure or piston engines.

The enormous velocity at which such engines must be driven so

as to operate economically, presented at first a serious impediment, calling for constructive skill never before demanded in this kind of work. The wheels of the engines to maintain lateral stability under such a high velocity had to be made of small diameter, and in the first examples were driven from 20,000 to 30,000 revolutions per minute.

The engines of C. A. Parsons, in England, and of Dr. de Laval, in Sweden, the only modifications that may be spoken of as in common use at this time, have been reduced in rotative velocity to a rate that seems to offer no serious impediment to the maintenance of the bearings and other parts.

In the Parson's engines the wheels are mounted on rigid spindles, and are so completely balanced that there is no preceptible jar or disturbance, in fact very high speed does not permit of synchronous vibration in frames or connected parts, and no jar at all, if the whirling mass is permitted to assume a theoretical center of gravity. This last-named feature is a phenomenon not very well understood, and seldom employed in machines.

Dr. de Laval mounts his engine wheels on small spindles that are flexible to the extent of permitting the mass in revolution to assume a perfect center of rotation. The same thing was sooner applied very successfully to centrifugal extractors in England. These machines are apt to be out of balance by an imperfect distribution of the material to be treated. Sugar, for example, which may lodge unequally around the sides of the cylinders, and to provide for this the bearings are movable, being held by springs that permit the wheel and axis with the load to "hunt up" a natural center of gyration after they are in motion. The reducing gearing for impulse engines has this far been simple spur wheels, and is likely to remain so, because there is no better mechanism for dealing with very high velocities.

Referring again to the characteristics or properties of impulse engines. Their economic relations are revolutionary. The proportion of weight and dimensions as 37 to 1, or even as 10 to 1, and the absence of vibration, are features that by inference should spread such engines at once over a wide field of use, especially for purposes of transportation, where the engine has to be carried with the load it propels.

The avoidance of weight, the absence of vibration, and difference in the room occupied, seem to constitute impulse engines in these respects ideal motors for propulsion on land and water, especially on

vessels, but there is the countervailing impediment of the variable speed, required in propelling apparatus for vehicles and vessels.

For regular journeys at sea an invariable speed, or a speed that cannot be varied without loss of efficiency, is not an insuperable objection, in fact for long ocean voyages the time in which a piston engine is working at a constant speed covers nearly all of its life and work, but when frequent landings are to be made, as in river and ferry traffic, there would be a considerable loss of efficiency by the necessity of varying the rate of the engine's revolutions, but not directly as the variation from a normal rate.

The same conditions apply to locomotives, but in a greater and perhaps prohibitive degree, but were it not for this fact it would be a reasonable prediction to say that in twenty years hence, if not sooner, rotary impulse engines would replace the piston type.

CHAPTER IV.

WATER WHEELS.

The term "water wheels," as applied to water motors, for centuries meant only two modifications, "overshot" and "undershot wheels," but both of these types have nearly disappeared in practice, and are replaced by modifications that have better adaptation, and are made at a fraction of the cost, but these old names are not yet out of use. They have been recently set forth in a work devoted to mechanical matters* by a statement that "water wheels comprise two types or classes, overshot and undershot."

Without discussing the qualifications of an author, who is capable of such an assumption, or the relevancy of the term "shot" in the case, a different classification can be assumed, one more in accord with the modes of operation, and corresponding to modern practice in water wheels, as follows:

Gravity Wheels.— These are the type called overshot, because the water is supposed to pass or be "shot" over the top of the wheel in the direction of its rotation, which is not always the case, however, because the water is often applied at the sides of the wheel at various heights, giving rise to the name "breast wheel," which

*Machinery for Metalliferous Mines, 1894.

like overshot is an irrelevant term. Gravity wheels are impelled by the direct weight of the water loaded in the buckets on one side, and descending to the bottom, where it is discharged by gravity.

Turbine Water Wheels.— The term turbine has come to be applied to several kinds of wheels quite different in their nature and mode of operation, but should on the grounds of relevancy be confined to the pressure class. The name comes from the French *tourbillon* (whirling, or turning around a center), and cannot well, aside from its etymology, be applied to but one kind of water wheels, those operating by pressure.

Turbines are driven by the pressure of the water resting against the vanes, or as may be said, by resistance to the escape of water under pressure. It is true that in analysis of turbine action there are commonly elements of percussion or impact, reaction and other forces mixed up, of which there is no practical proof, and the most rational, and at the same time the most simple way of understanding turbine effect, is to consider it as resistance to flow, and consequent subjection of the vanes to the static pressure or head, a proposition that harmonizes with the water "entering the wheel without shock, and leaving it without velocity."

Impulsion Wheels, without reaction.— This class of wheels includes what are called "undershot" wheels, current wheels, saw-mill wheels and tub wheels. They are driven by the spouting force or flowing energy of water, or by its momentum, usually after descending inclined chutes, the water, after its impingement on the vanes, being discharged at a velocity equal to that of the wheel, consequently about one half of the energy is lost.

Impulsion Wheels, with reaction.— This class includes tangential, Girard and other open water wheels, a very important type, now rapidly increasing in use and giving out high efficiency. Wheels of this class are like the non-reactive kind, impelled by the spouting force of the water, but are so constructed as to reverse its course, utilize the reactive force and release the water in a state of rest.

Reaction Water Wheels.— This class of water wheels, now little employed, operate upon a principle that is explained in two ways: (1) that the impelling effort or turning force is as the weight of the water discharged tangentially; (2) that the effect is due to unbalanced pressure, or a want of pressure at the discharge orifices,

leaving an equal area acting as a turning force opposite to the issues. Reaction wheels are commonly illustrated by what are called "Barker's mill," familiar to almost everyone, and described in works on natural philosophy.

Positive Water Motors.— This class includes certain rotary forms of water motors that are turned positively by pressure, and whose rate of revolution is a measure of the water consumed; also includes reciprocating engines with pistons impelled directly by water pressure. There are many modifications of this class of water motors, acting by both rotary and rectilinear movement, which will have farther notice.

Repeating this classification there are:

1. Gravity wheels, acting by direct weight.
2. Turbine wheels, sustaining pressure.
3. Impulsion wheels, without reaction.
4. Impulsion wheels, with reaction.
5. Reaction wheels, operating by unbalanced pressure.
6. Positive wheels and motors, operating by direct pressure.

These classes will again be taken up in succession, and considered in respect to their economic and other relations to use, and the conditions that may determine their adaptation in various cases.

It will, however, be proper to first remark that while the classification assumed harmonizes very well with the facts of modern practice, it does not do so completely, because there are many wheels that operate by a combination of the methods named. For example, by impulse and gravity, by impulse and pressure, also by impulse, pressure and reaction combined, such combinations seldom producing any additional effect over either method separately applied.

An excusable digression may be made here to remark upon the evolution of modern water wheels, which can properly date from the time of Napoleon I, who in the preparation of the great French Encyclopædia of the Arts and Sciences instituted under his reign, delegated certain subjects to eminent men to be exhaustively treated.

Among such subjects was that of hydraulic motive apparatus, which then for the first time received mathematical and analytical treatment, so consummate, it may be said, that but little of importance has been added since. The investigations of Fourneyron, Jonval, Girard and others covered the whole field of both sustained pressure and impulsive action. One exception, and it is a notable

one, is the centripetal or inward discharge type that has been developed in this country, mainly by experiment.

Turbine wheels, or wheels of high velocity, may therefore be classed in four types: The Fourneyron, Jonval, Girard and American or centripetal. These will be separately considered in future under their proper heads.

GRAVITY WATER WHEELS.

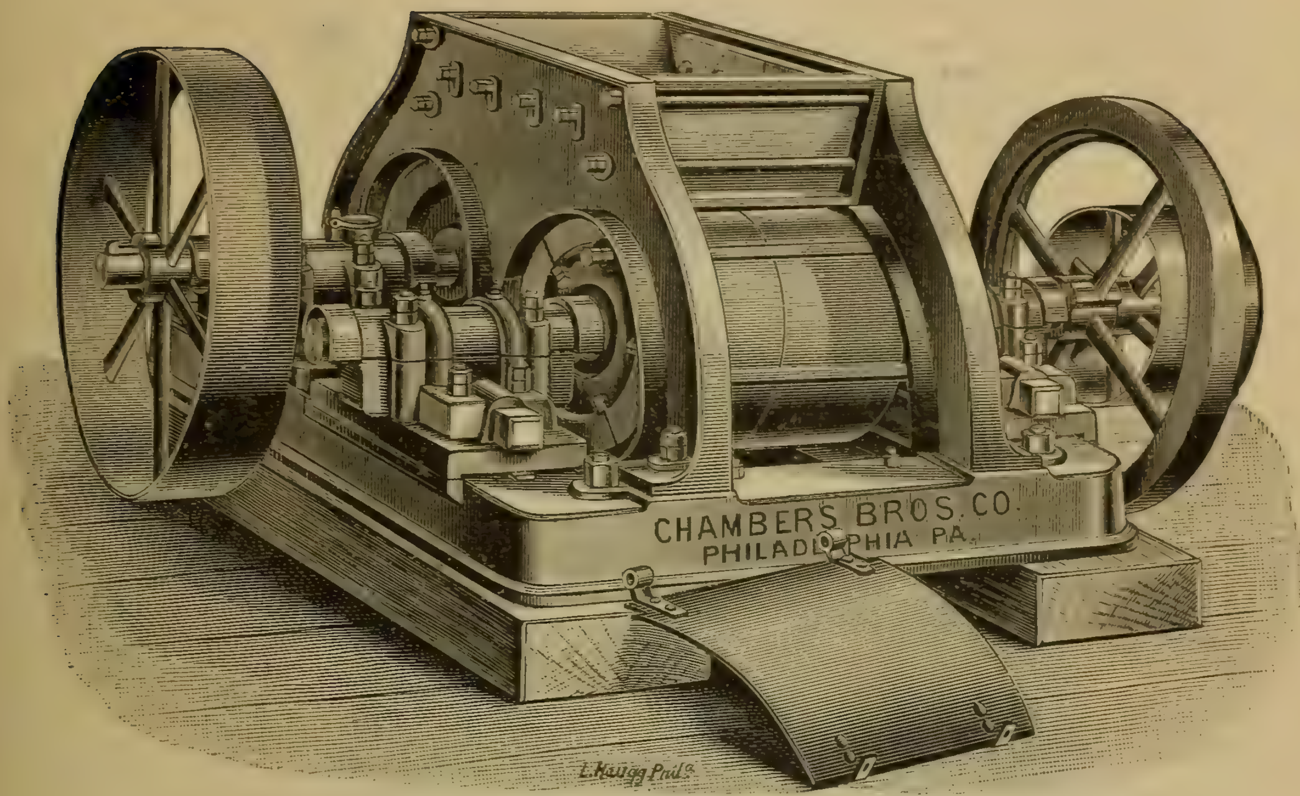
The first feature of these wheels to be noticed is that their diameter must be equal to the head or fall, consequently their rate of rotation is thus determined, and cannot be chosen or adapted to particular purposes, as in the case of other water wheels. They are also limited to falls that do not exceed a possible size for the wheels. This large diameter causes a slow movement of the axis, and renders necessary a train of multiplying gearing that is expensive, consumes a great deal of power by friction, and is liable to wear and derangement.

The wheels are expensive, usually exposed to the weather, consequently to corrosion if of metal, decay if of wood, to freezing in cold climates, to resistance by back water, and impossible to regulate for any but a very constant duty, and are now practically out of use.

A natural inference is that the water descending by gravity, as on the side of a water wheel, should give out its full amount of energy, but it must be remembered that the water in such descent does not move at a constant velocity, or one that corresponds to the law of acceleration, but with a motion represented by the ordinates of a curve of 180 degrees, so the motion is far from natural, although it may seem so at first thought. A few gravity wheels remain, like the great wheel at Laxa, in the Isle of Man; the Burden wheel at Troy, New York, and in some old mills.

Another form of gravity motors is what are sometimes called chain wheels, or a reversed Chinese pump, consisting of a series of pistons connected by links descending in a tube by the weight of the water. The method of operating is one of high efficiency, but open to so many objections constructively that the method has never come into use. A large motor of this kind was exhibited at the Centennial Exhibition, at Philadelphia, in 1876. The name of the maker is not remembered.

(To be Continued.)



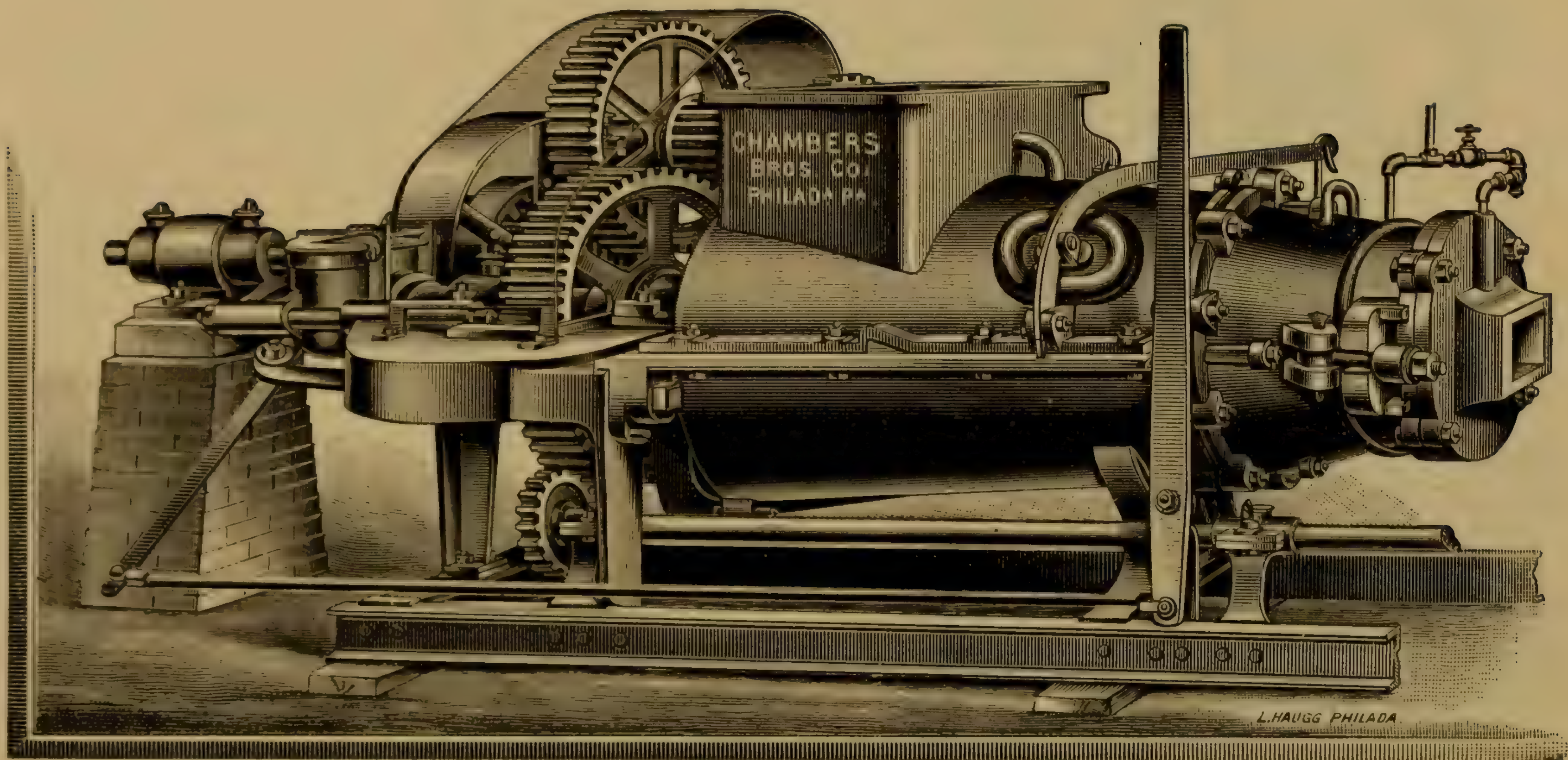
CLAY DISINTEGRATING OR GRINDING MACHINE.

CHAMBERS BROS. CO., PHILADELPHIA, PA.

Last month we devoted some space to clay-working machines, and continue the subject this month with some illustrations of brick-making machinery by Messrs. Chambers Bros. Co., of Philadelphia, the drawing above showing a clay-preparing machine, and the one on the next page showing a stiff clay machine without the cutting-off apparatus, off-bearing apron, and other accessories.

In the manufacture of brick with machinery there are three processes, and while these may be said to differ only in respect to the amount of water in the clay, they are quite distinct in nature and results.

The first method to be noticed, and the only one down to recent times, is that of first mixing or reducing the clay to a soft plastic state by admixture with water until it had the consistency known among brick makers as "mud." This corresponds to the old wooden tempering tub driven by horse whims, which all of us have seen, and which down to twenty-five years ago comprised all that might be called brick-making machinery. The compression on the clay was only what could arise from the dynamic efficiency of a horse



STIFF CLAY BRICK MACHINE.

CHAMBERS BROTHERS COMPANY, PHILADELPHIA, PA.

whim or sweep, consequently the consistency of the clay had to be such as would permit flow under this weak force.

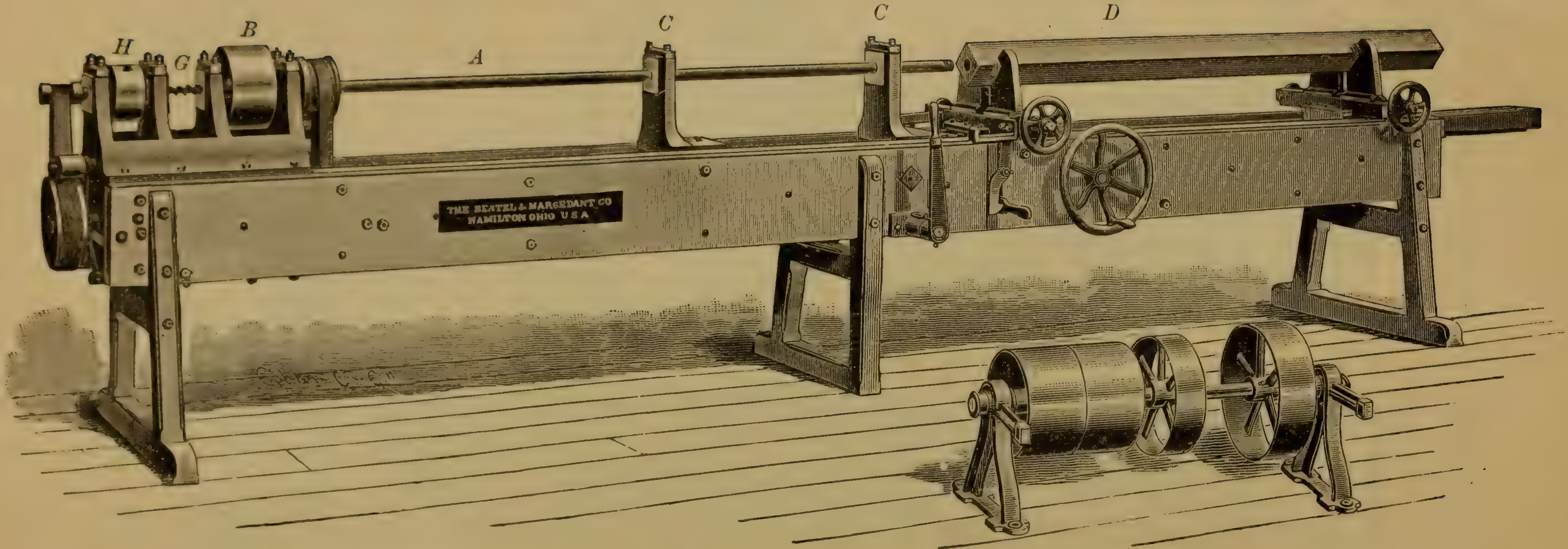
The second process, called the stiff clay one, consists in treating the material when only damp enough to cause cohesion and permit flow under great pressure exerted by powerful machinery, the clay being first disintegrated or "torn up," it may be called, by rapidly revolving cylinders filled with vanes or knives. This is now the method most common in brick making.

The third method, which we propose to describe in a future issue, is the dry-clay process, in which the brick is subjected to high pressure, the material containing but little moisture.

Reverting to the stiff-clay process, the machine shown on page 721 is a disintegrating one, having two cylinders revolving at different velocities relatively. The clay as it comes from the mine is fed in the hopper at the top, and after treatment is elevated by machinery and passes into a similar hopper on the main machine shown on the opposite page.

This machine consists essentially of a heavy cylinder containing a strong helix that forces the clay forward and out at the die, seen at the end, which gives lateral dimensions to the brick. The stream or bar of clay after leaving the dies is cut into uniform lengths, or into complete bricks, by devices of which there are several kinds, preferably helical knives moving coincidently with the stream of clay. The bricks when thus severed are sanded to prevent them from adhering together and permit their being handled, after which they are "off-borne" or carried away to a drying floor, and are after drying burned in a kiln in the usual manner.

There has been invented in England an ingenious instrument to indicate the working of steam and other furnaces, based upon the amount of carbonic acid that is passing off in the waste gases from the fire. It is an indicating apparatus, consisting of two bulbs, one containing rarified air, and the other smoke as it passes from the furnace. These bulbs are balanced on a delicate scale beam, which shows at once any rise or fall in the weight of the smoke, which varies with the amount of carbonic acid passing off, consequently whether the amount of air being admitted to the furnace is correct or not. It seems a simple and useful idea, but we can see no use for a bulb of air on one side of the balance beam, as any kind of a weight should answer the same purpose. The weight of carbonic acid gas is 50 per cent. more than common air.

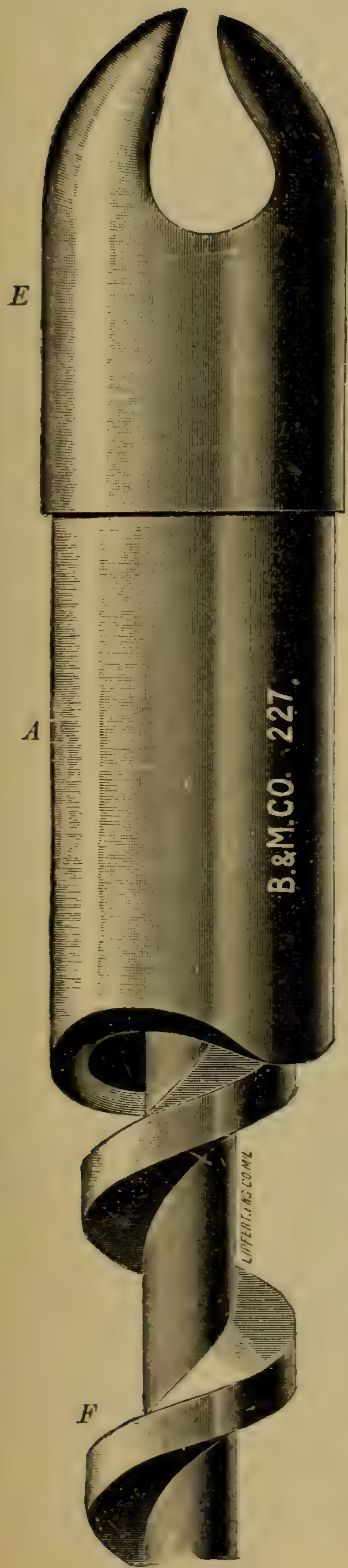


MACHINE FOR BORING WOODEN TUBES, PUMP BARRELS, ETC.

The Bentel & Margedant Co., Hamilton, Ohio.

MACHINERY FOR MAKING WOODEN TUBES.

THE BENTEL & MARGEDANT CO., HAMILTON, OHIO.



How long tubes of wood are bored, is a puzzle to most people as great as the problem to King Charles of "how the apple got into the dumpling," and is especially a matter of interest on this Coast, judging by the inquiries that have been received at this office during the last eight years.

Having ascertained that the Bentel & Margedant Company made a specialty of machines of this kind, we applied for information which has courteously been supplied, and will be published here and in our next issue, beginning with the boring process which may be called the base of the system.

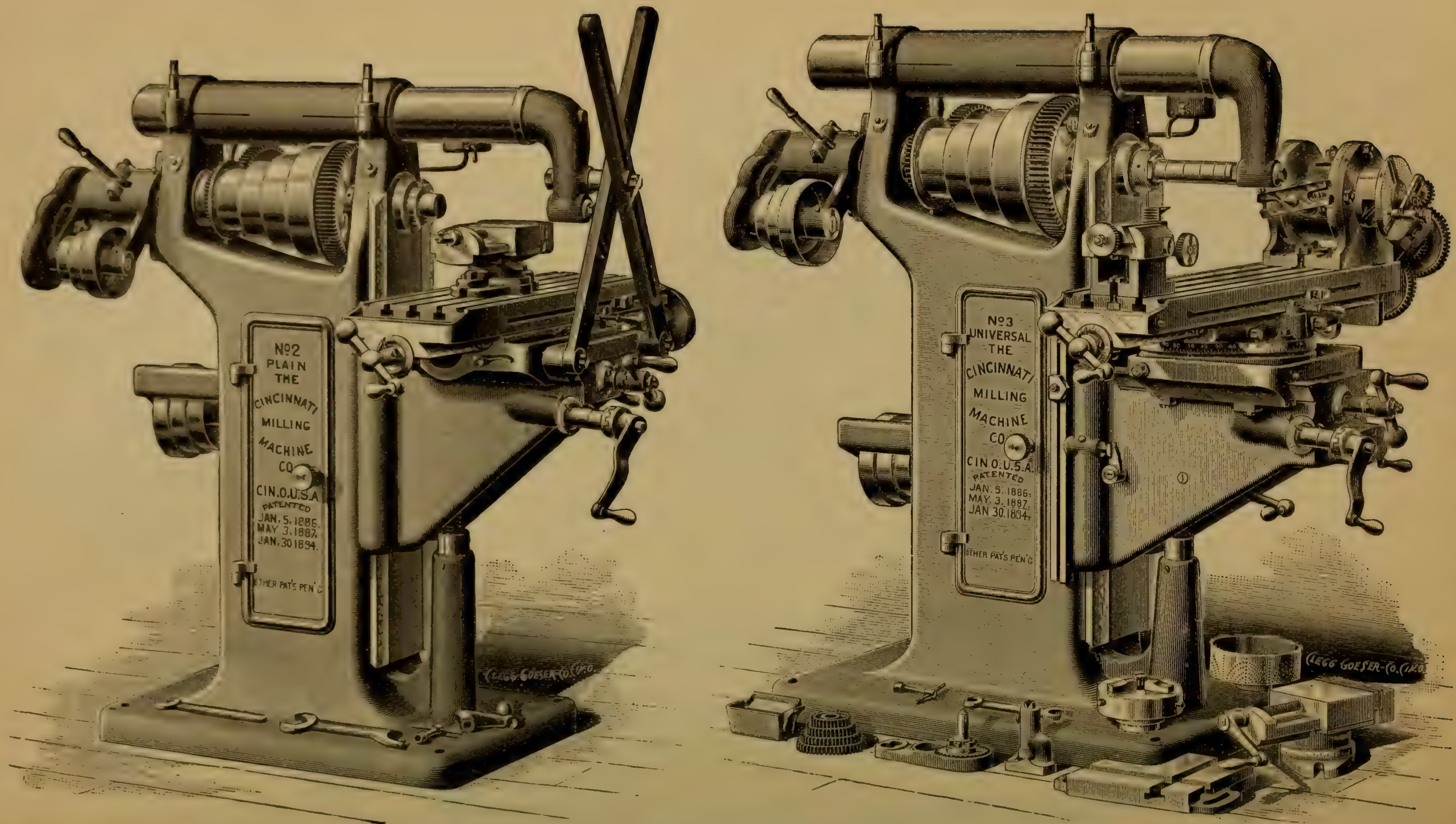
The machine shown on the page opposite is one for plain boring holes up to 4 inches diameter, and of any required length, the drawing representing a machine for boring wooden pump barrels eight to ten feet long.

On this page are shown enlarged drawings of the cutting and clearing implements, so the whole operation can be made quite clear.

The main frames are made of dry wood "glued up," as it is called, from boards to prevent warping. These frames are about two and a half times as long as the stocks to be bored, and could not well be made of metal. On the top are fastened planed ways on which slide the chucks that hold the timber *D*, the rests *C C* or other moving parts.

The boring barrel *A* is a thin metal tube, turned true, driven by the pulley *B*. On the forward or cutting end there is fastened a cutter *E*, shown above, having a bore the same as the tube, the shavings or chips passing inward.

Through the cutter of the barrel *A* and filling its bore is a helix *F*, that withdraws the chips through the barrel so they will fall out at *G*,



 UNIVERSAL MILLING MACHINES.—THE CINCINNATI MILLING MACHINE CO., CINCINNATI, OHIO.

Fig. 1. The helix or screw F is milled out from solid steel, quite smooth, and is an expensive element of the machine. This screw is driven by the pulley H at a much higher rate than the barrel A, in the opposite direction.

The operation of the machine is automatic, that is, the stock D is moved forward by feed gearing operated by the belt and pulley seen at the end of the machine.

The truth of the work depends on the correct alignment of all the parts, which in a machine of this length requires careful construction. A machine as shown, to bore eight feet long, costs $460.00, which seems a low price.

UNIVERSAL MILLING MACHINES.

THE CINCINNATI MILLING MACHINE CO., CINCINNATI, OHIO.

The rise of machine tool making in Cincinnati, beginning about 1865, or thirty years ago, is an important fact in the industrial history of this country.

At first, for ten years or so, there was not much departure from good precedents elsewhere, but then began various additions and changes aided by a more direct contact with the great Western market, and finally came the venture into the highest types and the most intricate machines, among other things universal milling machines of the highest class, including various refinements, which are much better set forth in the fine engravings on the opposite page, than can be done in words, even if we had the space for lengthy description.

Our attention was called to these implements by the awkward looking diagonal stays seen on the smaller machine, but which for heavy or long cuts will impart a rigidity in all planes not attainable by the ordinary overhung supports, or by some less effective devices that have been employed. Of course the machines are complete without this attachment for ordinary work, but it is important for the heavier kinds of duty and need be applied only in such cases.

The variations of feeding movement have always been too few, and the extremes insufficient, but in the machines shown there is at the rear end of the main spindle a system of change wheels that in combination with the step pulleys give twelve changes of rate for the feeding movements.

The machines are made by the Cincinnati Milling Machine

Company, who devote their whole attention to machinery of this class, and in this way attain not only excellence but cheaper production of what must necessarily be high priced machines.

We note another new feature in swivelling tables that may be mentioned, an extremely broad base and an avoidance of built-up height in the work supports. The various adjustments are a study and a result of evolution in design.

Continued from page 648.

WORKS ADMINISTRATION.

Lectures before the Students of the Leland Stanford Junior University, Palo Alto, California.

BY J. RICHARDS.

[No. 2. October 24th, 1895. Published by permission.]

ESTIMATES FOR WORK.

Proceeding now to a more practical consideration of the subject of works administration, the first thing to be considered in this, as in all human activities, is, what are the main objects in view? This lets us down from the ideal to sordid ground, and the answer must be "commercial gain." It is a most unromantic conclusion, and is perhaps not quite true, because human pursuits, besides providing for our physical and material wants, also provides an agreeable field for the cultivation of our faculties and the pleasures of accomplishment, but construed in the abstract, the primal object of industrial pursuits is commercial gain, or, to reduce it to lower terms, is an attempt to produce commodities at a cost less than the price they will sell for.

This is a bald qualification, but it must be kept in mind as an objective point in each and every operation that we call productive industry. This being the case, and as the cost of commodities comes before their sale price, we will first consider cost. In this little term of four letters lies a potency that consumes the highest ability of our ablest engineers and mechanics.

It will be difficult to realize what this includes in a works; and you will no doubt be surprised when I say that a principal work of Mr. Dickie, Manager of the Union Iron Works, who recently lectured before you, is to ascertain and inform his company of the cost of producing work. This work of estimates compasses the whole range of constructive engineering work, the natural proper-

ties and adaptation of material, its cost, all the methods of manipulation, the expense account, engineering service, risks of all kinds, and contempcrary values.

I have known Mr. Dickie, who is an engineer of the highest standing, and with a charge as responsible and difficult as is filled by any one in his profession, to shut himself up for months in his private office to find out the cost of producing a warship. When done, this cost, set forth in thousands of items, filled a book as large as a merchant's ledger, and a hundred times more intricate, because the work involved to a great extent both methods and design.

This work is called estimating, and is the first process in undertaking work, or, as we may say, the first step in the practical conduct of a going works. There are usually in the corps or staff of a works plenty of men who know how things are made, how sold, and how collected for; how material is bought, stored, handled and cared for; how drawings are made, weights ascertained, and all this, but the prime cost derived from the assembling of all these things, with the "allowances," margins for error, changes of prices, the facilities for production, and so on, calls for the highest ability.

Twenty years of experience has in the case of Mr. Dickie, and other engineers of like long service, enabled organization and classification that materially assists in estimating. There is also a good deal that can be delegated to a staff, but in no other part of the world is there so much labor and responsibility in estimating as on this Coast, because of the extreme diversity of the work performed and the fluctuations of prices.

ELEMENTS OF COST.

Proceeding next to analyze this matter of cost, it consists essentially of four elements or components, namely: material, labor, expense and profit. I must beg you to keep these elements in mind. They are present in every commodity produced, from a pin to a steamship; the three first, labor, material and expense, absolutely, and the fourth one, profit, necessarily in all successful business. Profit is a very important element, the qualifying one indeed, and properly belongs to and should be included as a definite component in all estimates. This, as you will see, corresponds to the proposition first laid down, that the prime object of industry is commercial gain, and when done, if I am able to present the subject of cost in a proper manner, you will find that the various elements corelate, and qualify each other the same as the factors in an equa-

tion, and I hope that some of the students here, with the suggestions of their able instructor, will attempt to put these elements of cost into mathematical expressions of some kind, if not into regular formula. I once attempted something of the kind, or suggested it, in a paper read before the Technical Society of the Pacific Coast, under the head of "The Labor Element in Engineering Estimates," but found at the time that the subject had a political bearing and so had to abandon it.

These four components, labor, material, expense and profit, it may be thought are so simple as to not require much explanation, but this is not so. Their division and relation is often much involved. The value of these factors vary, not only in different places, but also at different times in the same place. What we call labor, if it includes all personal service, has to be distributed through various departments, a portion of it going to the expense account, and a portion to constructive or productive work, or entering into cost directly.

This distinction between expense and labor is commonly made by classing labor in two divisions, one productive and the other non-productive, or, as said, belonging to expenses. Productive labor is that which acts upon and changes material, the mechanical part, including handling, and whatever is carried on in a work shop necessary to construction.

The other kinds of labor chargeable to expense are account keeping, clerical work, a portion of the draughting, and so on, as will be understood when we come to speak of the expense element. This division between the labor of production and that of expense is quite a complicated matter in the sense that such division is not uniform, but varies in different branches of manufacture and in different works, also by different methods of keeping records, but it must be remembered that if anything is taken from one component it must be added to another, the aggregate of cost is the same no matter what difference of methods may be.

EXPENSE AS A COMPONENT OF COST.

The expense element is a flexible one. It includes rent, light, heat, water, insurance, travelling, drawings, accounts and records, office service and management other than immediately in the constructive departments. Expense may be classified by the rule that it includes whatever disappears, and has to be continually replaced or reproduced; also as whatever is not sold. Or to qualify it more

plainly still, whatever is not converted into merchandise and is not sold. In the works, sand, oil and files are expense, but paint, packing and screws are merchandise, and I will here mention that the separation and classification of the various supplies for a works into merchandise, expense, implements, and so on, is a very interesting and useful exercise.

As accounts are commonly kept in machine works, and they are typical of all kinds of manufactories, the charges to expense are from 15 to 30 per cent. It is, as has been said, an indeterminate quantity, depending in a great measure on the means employed to sell the product. For estimates it is commonly assumed from precedent or former records, an average being taken over previous years, or by analogy to similar business of like nature and extent.

Expense varies with the volume of business, but not directly. It is least in a very large and in a very small business. A very small business is sometimes carried on with the expense account almost eliminated. To extend a large business does not call for a proportionate amount of highly-paid service, and the expense of all elements fall off in greater or less proportion with an increase of volume. Material is purchased cheaper in proportion to quantity. A cargo of coal, iron or timber is bought cheaper than a car load, and a good deal cheaper than a wagon load; besides the handling and storing of a large quantity is cheaper than for a small quantity if charged against the volume or amount.

Steam power does not occupy room and require attention in proportion to horse power, but it costs less in both of these and in other respects as the capacity is increased. It will require the work of one skilled man to manage an engine of twenty-five horse power. Sometimes one man will manage and care for an engine and steam plant of one hundred horse power, but it does not require four men for four hundred horse power, or ten men for a thousand horse power.

It costs nearly the same to advertise a business of fifty men as it does for one of five hundred men. For example, if we assume that the expense element in production follows inversely as volume or amount of product, small shops could not exist. They would be eaten up by the expense account. But small shops do exist, as we all know, and sometimes persist in existing when the larger ones fail, and it will be almost an anomalous proposition to say that this very expense account gives them a tenure of existence and a chance of success.

While it follows upward in some proportion as before named, it does not do so from the beginning or from a small shop, but from an aggregation that may be called a works. The unit is of course the work of one man, and, as we all know, one man makes up the working force in many kinds of operations, as in watch and clock repairing shops, dentist offices and country blacksmiths. Sometimes in a small machine shop one man may carry on a business with his own work.

The dividing line from which an expense account seems to diminish each way is where the division of labor and processes begin; in a machine business, when a clerk, draughtsman, smith and foreman are required, or, as we may say, for most kinds of manufacturing operations, when twenty or more men are engaged.

With a small business, tapering downward, so to speak, from twenty men or so, the expense account begins to drop off. Advertising, draughting, superintendence and other expense elements are avoided, picked up, or added to other service, often contributed outside of working hours. All of our industries were once carried on in this small manner, and however impractical and inexpedient it may be now, there was much to commend it in respect to certain social relations it brought about.

In the older countries the system of segregated industry, watch making in Switzerland for example, many industries at Birmingham, England, and in the northern cities of France, certainly led to many features of social life that are impossible under the factory system. These results are to a great extent exemplified in the agricultural pursuits of our own and all other countries at this day.

As, however, ethical matters do not belong in the present connection their discussion can be left to a future place, when methods of discipline and the social relations between owners and the workmen will be considered. But without wholly leaving the present subject of the expense element in manufactures we may proceed to inquire a little into the causes that have so completely changed the methods of industry to the factory system.

THE FACTORY SYSTEM.

Chief among these is motive power. When operations of all kinds were performed by hand, a few men, or even one man, could work independently, but when power operations were introduced it required a considerable volume of business to warrant the maintenance of a steam engine or water power, so it became necessary to

increase the size of works, and when increased from this cause up to what might be called a full works a further increase was demanded to diminish the expense account and other elements of production.

Another cause of aggregation was in implements. An expensive machine or tool may be required for some operation, and to provide such a tool without loss it requires to be kept at work. This is true of a great many implements, and unless kept at work they slide over into the expense account and eat up profits at an alarming rate. It was this fact more than any other that brought about tool combination and combined machines, which is to form an important part of these lectures when we come to manipulative processes.

Another and principal cause of aggregation in industry, or the factory system, as it is sometimes called, may be noticed here, especially as it has a direct bearing upon the expense element in manufactures, that of the division of skill on the grounds of dexterity. This matter will never be better or more ably presented than it was a century and a quarter ago by that remarkable man, Adam Smith, who, in his *Inquiry Into the Wealth of Nations*, used the manufacture of common pins, as then carried on, to show the effect produced by a division of skill.

At that time pins were cut from wire, the points were formed by hand, and the heads made by means of open collars bent to a circle and forced on to form a head. One man performing all these different operations could make only a few dozen pins in a day, but when one man cut off the wire, another pointed the pieces, a third coiled the heads, and a fourth put the heads on, the average production by reason of special skill was increased five fold, and the cost was wonderfully reduced in this way.

There are, however, many reasons for the aggregation of industry, too many to be mentioned even, but at this day one of a potent nature, quite unknown a quarter of a century ago, is that of extensive combination between works of one kind or class with a view to monopoly, but generally under the pretense of reducing the expense element in manufacture.

I have merely touched upon some of the conditions that affect expense, but have presented enough no doubt to show its complexity. The rest must be left to your own investigation, with the assurance, however, that while the expense account in a particular business or establishment may be very nearly determined, there is no set rule that will cover all or even many cases.

There is a rough rule for determining expense and profit together,

followed in a large number of cases, that applies in machine shops making a miscellaneous line of work, a kind of lazy man's rule, but convenient withal, and much better than no rule at all. It is that of adding a percentage to the labor account to cover profit and expense. A common way is to double the wages account, and add it to the material to make up prime cost and profit. Material being what we call a fixed component, and labor bearing a very constant proportion to expense, it is evident that a rule of the kind above named will answer tolerably well in average works, but for any kind of regular manufacture in which commodities are duplicated, and this is the only kind of work to which the term manufacture applies, the amount set off for expense and profit by this rule is too great.

When there is kept a net or specific expense account to cover certain things, estimating the cost of work becomes more difficult, or rather is more extensive, but is more exact. In some works, especially large works, the expense account falls as low as fifteen per cent. of prime cost, that is, the components included in this account do not exceed fifteen per cent., and a good many things properly expense are charged under other heads. Among such items, and especially in this country, is the use and maintenance of capital. Use meaning the interest on investment, and maintenance the assurance against risk. Both these things will be considered under the head of capital in a future place.

One reason for lumping labor, expense and profit in one account for the purpose of estimating, is the difficulty of determining what net labor cost or wages amount to. It is customary, as you all know, to furnish workmen with what are called time tickets, on which are entered each day the hours and fractions of hours the men have been engaged on certain jobs in the works.

The sum of time on these tickets is made up by the clerks and charged to the different jobs, also compared with the time roll or general time account and wages account, so that when any work is completed it is easy to make up the exact amount of wages paid out for the work, but the amount thus found will not do to enter in a prime cost account. There are a good many things to add to it. Among these are management or superintendence, accidents and mistakes, inefficiency, apprentice work, holiday privileges, and other things that properly belong to the labor element, but may be, as before explained, included in an expense account.

THE RELATIONS OF SKILLED LABOR.

The labor component in skilled production presents at this time the greatest social problem that has ever confronted the world. Previous social problems that have led to the slaughter of thousands or even of millions of people, and have destroyed and upraised States and Empires, have always had their root in oppression that denied physical comforts and rights to laboring people, but now the problem has assumed a new phase, and is argued upon the rights and relations of labor compared to the rights of investment, commercial skill, and the division of profits.

It will not be proper to include in these lectures a consideration of the social and economic relations of skilled labor. The subject is too broad, and far beyond the powers of any one to discern and explain at this time, but it will be proper to treat upon the technical causes, they may be called, that lie at the bottom of labor disturbance in skilled industry the world over.

These causes lie mainly in the works, or in the working relations of men, we may call it, and rise out of the labor component in production; how it is managed and paid for. In the first place, and as the main fact of all, must be considered the altered relations that workmen bear to the processes of production and to their employers. It is not very long ago that skill meant manual dexterity and empirical knowledge. The consideration returned for wages was manual skill, qualified by experience. A man was much like a machine, capable of higher powers to be sure, but his main functions were those of a machine.

This placed the workman in the social scale next to the slave, where he remained for centuries. The master did not own his person, but owned his time, which was paid for by the day, week or month, without any defined or definable measure of what the workman should do for his wages. The incentives to work were his sense of honor, necessity of his wages and the fear of losing his employment. Not very high incentives one may say, but all that exist in a time-pay system, yet prevalent all over the world, but no doubt to end before very long in a more equitable and logical relation between skilled labor, capital and community.

Time labor, or the employment of men's time in productive work, or in work determinable in the terms of production, is an anomaly. The things employed are not only manual and empirical knowledge, but also, and in many cases mainly, inductive and

deductive mental skill ranking with or above the commercial conduct of a business.

Men are no longer machines. We have the machines separate from the men, and employ the latter to contrive and direct the machines. This in skilled industry places workmen in a new and higher position socially, or should so place them. But there is one impediment to this, one that is not commonly known or recognized, that of the slowness with which all social changes take place.

A period of fifty years has been enough to change nearly all the processes and methods of manufacture, calling for an entirely new relation of workmen to their employers and to community; but fifty years can work but little change in social relations. It is not two generations, and there are men living now and working who were reared and learned their art under circumstances that have passed away. The progress made by science and in the mechanic arts has no such limit of time. In ten years the change is more than a century can produce in the social relations of men. Science and discovery outrun social change in such degree as to prevent comparison, hence the unrest and disturbance abroad in the land.

Looking at the problem practically it may be observed that each year, each essay, and each investigation brings us nearer to the fact that time work must cease in our skilled industries. Down to a few years ago no one had perceived this. The existence of some disturbing cause was plain enough in the discontent and demands of labor, but the real cause was not suspected. Various schemes of a paternal nature, such as profit sharing, were and are still urged as a remedy for labor disaffection, and in some cases, when carried out in good faith, have been successful in so far as preventing strikes, but such means are only palliative so long as labor is paid by time and workmen are not made responsible.

In this term "responsible" lies the secret of the whole matter, the distinction between slavery, time service, and contract service. I will attempt to make it clear by means of the internal relations of a work shop, and must remind you that it is a very practical question that you will find is one to be dealt with in a serious manner, and very soon, in this and all other countries where skilled industry is carried on.

To prove the pressing nature of this problem, I need only refer you to the department in the principal technical journals of England, embracing from one to three pages in each issue, under the head of "Industrial News," and to the existence of labor

bureaus in at least a dozen States in this country, and a National Bureau, at Washington, devoted to the same subject; also to societies formed to promote means for the avoidance of labor dissensions, and the publication of a journal directed to profit sharing with many other panaceas for labor disturbance.

As before remarked, we cannot enter into the ethical, social and economic phases of the labor problem, further than it is connected with works administration and the practical conduct of industry, but this will be a good way, because it is to be questioned if all the writing, speaking and philosophizing about labor relations for the past ten years have done so much toward a solution and settlement of the problem as a single one out of a number of shop experiments made in this and other countries.

Of particular cases we will speak farther on when some previous consideration of the subject will prepare us to understand the nature of the experiments made. To begin with, we may classify skilled service under four heads:

First.— Slavery, where the workman is wholly irresponsible.

Second.— Time service, where he is partially responsible.

Third.—Piece work, where he is responsible for his own work alone.

Fourth.— Contract work, where the whole working force is collectively responsible.

Now these four methods or systems of service have the measure of responsibilty named, from nothing to all. Responsibility is the key to all human actions that are voluntary and not a sequence of necessity. This proposition may seem a strange one, but it is certainly true. Whether it be a cause or sequence, or both, we need not stop to inquire so long as we find it the constant characteristic of contented and efficient effort on the part of those employed.

In respect to slavery, that no longer exists as a provision of law in any country where skilled industry is extensively carried on, and we need only to refer to it in illustration. The slave is not responsible for the product of his labor. It may be more or less in proportion to what his master gives in return, but personally the slave is not responsible, because not a free agent. Emulation, respect, and a sense of duty may in a limited degree enter into his incentives, but the subordination of his will and fear of punishment, are the main causes that enforce service. The system has happily passed out of the world in so far as pursuits involving skill, not as a deliberate policy so much as by the force of circumstances. I am

old enough to have seen a good deal of it in this country, and learned some lessons that may unconsciously enter into views now being laid before you.

Time work, wherein the workman is paid for a term of service, yet the most common form of employment, stands next to slavery. Not near to it perhaps, but next in the movement toward responsibility, and is practicable only because of a sense of personal honor and of justice due to the high degree of civilization existing in countries where skilled industries are carried on.

Workmen under this system are responsible so far as their sense of honor and emulative pride produces responsibility, but no farther. A man is hired by the hour, day, week, or month, but the contract is indeterminate. If he spoils his work or fails to render such service as common custom demands, he can be discharged and nothing more. If he spoils work or fails by incompetence to earn his wages and a profit for his employer, it makes no difference, the law will give him his wages irrespective of everything but wilful negligence and the malicious destruction of his employer's property.

What a remarkable compliment to the integrity and good faith of the skilled workmen of our time! Contrast it with the usages of common trade. If exchanges were to the same extent based on good faith and manly honor, would a like result follow? I am not claiming that faithful service is always rendered from honorable and unselfish motives. The penalty of discharge is always present, and the sentiments engendered by unions or trade organizations are often independent of any interest in employers or of community outside of the union, but we can only wonder that the circumstances are not worse when the nature and manner of controlling service by time pay are considered.

EXISTING METHODS OF EMPLOYMENT.

The present extent of time work in skilled industries is a strong argument as to its necessity under modern circumstances, but it is not universal, and is constantly becoming less so. Greater progress would have been made toward a better system long ago had it not been for the strong efforts that have been made toward paternal systems, such as profit sharing, by earnest and philanthropic men in most cases, but mistakenly in so far as meeting the real causes that lie at the bottom of labor dissension.

Such a proposition as this needs some defense, and in that way one may ask, what have workmen to do with profits not earned by

their efforts and skill? Only a part of the profits in an establishment are thus earned. They depend on a good many things beside faithful and efficient labor, and if profits not so earned are divided with workmen, it is a gift or bribe that destroys independence and responsibility. Workmen of our day do not want such favors. What they want and need is justice, fair dealing and responsibility for what they themselves perform and produce. They have as much reason to risk their labor as an employer has to risk his capital, service, management and implements, and all that is wanted is to segregate the labor component, and let it rest upon its own responsibility, and do away so far as possible with a time system of service. It is degrading in the skilled industries of our time, and while it cannot be at once removed, a beginning can be made, and above all we can study its nature and effects in the labor problems now convulsing the industrial world.

Next we will consider the piece work system, by which is meant personal contracts with particular workmen — a mixed system in which a part of the working force is made responsible, and the rest is employed on the time method. This is a bad system in many ways, condemned by the trade unions for many reasons. In the first place it is discriminating and unequal, and secondly there is no impartial standard from which prices can be determined. The rate is a matter of chance, depending on the whim, choice or conscience of the employer. It is a provincial idea, so to speak, and is a crude effort toward a contract system. It increases the responsibility of workmen without adding to their independence, does not succeed unless very carefully adjusted, and is unnecessary.

We are well aware of the extent to which it has been carried out in various shops, especially in New England, but if one will look into the matter carefully it will be found that wherever successful, there has been some features of a contract system involved that modified discrimination among the men, and that rates were not fixed by accident or independently in each shop. It is an undemocratic idea, not consistent with the spirit of our times, and will, no doubt, pass away for something better in the future; not very soon, perhaps, because these customs are tenacious.

The next system of service, if that term applies, is what has been called the contract system, or as we may call it, the responsible system, in which labor is set off as an independent element in production. This will consume some time, and is well worthy of it, because there is no one here who will go out into the activities of

the industrial world without having to face and deal with the labor problem. It will be discussed widely, and press more and more for solution, as education and competition goes on.

The conflict between capital and labor, that many prophesy, has no grounds in fair inference, if reason and fairness are permitted to enter into the controversy. To assume anything else is to accuse skilled men of being vicious, unfair and ignorant; also is to accuse employers of being dishonest and illogical. There is no need of a labor war in the sense of violence, or even of disturbance of our manufacturing industries, to which labor dissensions are now principally confined.

To make clear what is meant by a contract system of labor, the best way will be to illustrate it by an assumed example, and as one class of manufactures is as good as another, one of the most familiar, a joiner works, will answer the purpose.

In a factory of this kind are prepared all kinds ot timber, house furnishing material, such as flooring, ceiling, doors, sash, frames, mouldings, and so on. All these things have regular prices, because made very uniform for average houses, and there are price lists published that apply over wide districts, and for some things, like doors, sash mouldings and flooring, the lists apply to the whole country within reasonable distances of transportation. The work, when not included in the price lists, is made to estimates in which the labor is always made up as a separate item, and the labor in listed articles is either known or ascertainable in all establishments; is better known indeed than the other elements of material and expense that must be included in estimates.

Suppose then that a joiner works is to be established, and the owners instead of hiring men by time to do the work, establish a contract system for the labor. The men are employed as in any other case, and are permitted to draw a certain amount of money each week in proportion to the usual wages paid in such establishments, but are informed that work is all contracted to the men, or to the shop, as we would say, and whatever money was advanced for wages would be deducted from the sum due at the end of the week or month for work turned out. The men being apprised of or already knowing the rate for making standard work, no difficulty would arise from this, and as all irregular or special work would have to be estimated and include the element of labor, that amount could be posted in the works, or entered in a book kept by the foreman and accessible to the workmen. Each man would, as is the present

custom, enter each day on his time card the number of hours engaged on different jobs, which would, as is also the custom in most places, have a catalogue or order number, that would be entered on the tickets, with the time given to that number or order.

The whole shop is now working on the contract system. Every man, boy and apprentice is included, and at the end of a month, a week, or at any other time convenient, the completed work is made up and compared with the amount paid out in advances to the men. If there is a balance due them it is divided pro rata among all in proportion to their rank as indicated by the weekly or daily wages on which the advances are made. If there is a deficit the men must make it good by a corresponding reduction.

All losses by accident, carelessness or inefficiency of the men should be made good to the firm or company, and all losses chargeable to the owners by detention, want of material or implements, or accidents due the plant, would have to be made good to the men. If a man seeking work represents himself falsely as to his skill or rank, the owners need not concern themselves about that. The men in the works will attend to that matter, because if rated above his capacity he would be imposing on all the rest, and lowering their wages.

The establishment would be coöperative, divided into two departments or interests closely allied and interdependent. The workmen would have nothing to do with profits, risks or capital, except to help sustain these as a foundation for their own part, the labor, and their profits would depend on their own efforts and skill. No foreman to watch the men would be required. They would do the watching themselves, and do it in an effective manner. Drones would be weeded out, or what is more likely, they would be reformed, or not exist at all under such a system. The working force would be independent, interested and responsible. If a man needed assistance or favor, the whole force could extend it by giving him easy work, or in other ways. It is an ideal system, but would be pronounced by a good many impracticable, and as some answer must be made to objections I will begin by an illustration.

Many years ago I had the misfortune of attending a political convention composed of all kinds of people, all of whom were presumed to understand laws, legislation and the general conduct of the Nation. The chairman, as now remembered, was the keeper of a livery stable, a loud, positive man, who was emphatic and final in his rulings. Some one moved the previous question and cut off

debate in some motion that was passed, but a member arose and protested that under the circumstances this could not be done. The chairman arose in his wrath, and said: "Why, you ass, it *has* been done."

This applies to the contract system of labor. It *has* been done, not in one instance, but in hundreds of cases, and thousands of men are working on this method at this time. Not only this, other systems with a similar object infinitely more intricate and difficult have been in use for years, as witness the paper of Mr. F. W. Taylor, of Philadelphia, on "A Piece Rate System of Labor," read before the American Society of Mechanical Engineers, at the Detroit meeting in June of the present year.

I may also refer to an essay of my own, prepared some months ago for the editor of the *American Machinist*, and republished in "INDUSTRY" for January and February, 1895. In this article are a number of facts bearing upon the contract system of labor, also an explanation of it much fuller than the plan of these lectures will permit.

It must be admitted that a good deal of time and education would be required to introduce the system. All changes that affect the social and economic conditions of people come about very slowly but certainly, if founded in expediency, justice and proper objects. The impediments are many, and not to consume more time here it is suggested that objections handed in will be answered as well as possible at a future lecture.

One more thing in this connection; the most important of all, indeed. What would be the effect of a contract system on strikes and labor dissensions? The answer will be found by searching for causes of dissension in such a system, and the circumstances under which a strike or quarrel could occur, and it will be hard to find or imagine. There has to be various things settled, as experience has proved, but there is no difficulty in that, and here again I must quote the chairman of the political convention. I have had the honor to sit as judge in cases of dispute under the contract system, and must admit that the duty was congenial and easy. The thing *has* been done. No class of men in the world are so amenable to reason, logic and common fairness as mechanics. Their calling demands the continual exercise of reasoning powers, and is devoid of sophistry, deceit and cunning, common in many other callings, such as small trading and trade soliciting as carried on at this day. This I assert on the authority of an experience of thirty years in

the works, all the time in charge of men, and an inability now to recall in all that experience a single case of unreasonable demands, a strike even, or other trouble that led to the loss of so much as one dollar.

(To be continued.)

SOME IMPORTANT DECISIONS IN PATENT CASES, 1894.

U. S. CIRCUIT COURTS AND COMMISSIONER OF PATENTS.

Most of the decisions rendered in patent cases are special, that is, affecting certain issues in particular cases, but more or less of a general nature. The following ten are selected from the latter-named class, and contain information of importance to those interested in patent matters. We have, where required, endeavored to present the meaning of the decisions in more simple terms.

1. Recital of, but failure to claim, an element in an application as first filed, was no abandonment of such element, when the same was subsequently claimed in the prosecution of the application. *Pittsburg Red. Co.* v. *Cowles Elec. Co.*, U. S. C. C., E. Ohio, LXIX, 789.

An applicant has the privilege in amending his claims to include subject matter not embodied in his first or original claims.

2. A patentee will not be limited by the letter of the claim to the form claimed, when the form and substance of the invention are separable. (Citing *Winans* v. *Denmead*, How., 330.) *Reece Button-Hole Mach. Co.* v. *Globe Button-Hole Mach. Co. et al.*, U. S. C. C. A., I Cir., LXVII, 1720.

3. A broad construction of the claims, which might have been sustained in a pioneer device, will not be permitted in one not pioneer and of doubtful utility. *Deering* v. *Winona Harvester Works*, U. S. S. C., LXIX, 1641.

The term "pioneer," here employed, means original invention instead of improvement, and that in such cases the claims can be broader and more comprehensive. This is but affirming the custom of the office. The strength or scope of any claim must rest on novelty, and as novelty rests on precedents the ruling quoted does not seem to affect common procedure.

4. Process and product may now always be joined in one application, at the option and risk of the applicant, and the Office will no longer concern itself with the inquiry whether the article might be made by any other process or whether the process will necessarily result in the particular product to determine whether division should be required *Ex parte Thomson*, Comm., LXVI, 653.

5. The right of an applicant to renew a forfeited application under Section 4897 is exhausted when once exercised. *Sec. of Interior*, LXIX, 639.

When the issuing fee has not been paid within six months after the allowance of a patent, the applicant can renew his application

but once. If such renewal was not limited a patent could be sustained indefinitely by renewals.

6. It appears that when the owners of an invention submit to delays on the part of the officers of the Patent Office which they have it in their power to prevent, such delay serving to unduly extend the period of their monopoly of said invention, such conduct constitutes a fraud upon the public, and the patent should be annulled by the Court. *U. S. A.* v. *Am. Bell Tel. Co.*, U. S. C. C., Mass., LXIX, 1778.

This decision was given in a case for the repeal of letters patent, and is as just as it is important. It related to an attempt to resuscitate the Berliner patent in telephones, but the decision in so far as that case, was afterwards annulled in the Court of Appeals. It will seem that as long as the office is culpable in such cases, the decision is especially directed to the action of the Bureau.

7. Joint inventors being tenants in common and not copartners, request by one of them that the patent issue jointly to his assignee will be observed notwithstanding the opposition of the others. *Ex parte Fowler et al.*, Comm., LXIX, 1641.

8 One who merely suggests the idea of devoting an old article to a new use, without any change in its form or structure to adapt it to its new use, is not entitled to a patent therefor. *Browning* v. *Col. Tele. Co.*, U. S. C. C. A., VIII Cir., LXVIII, 1145.

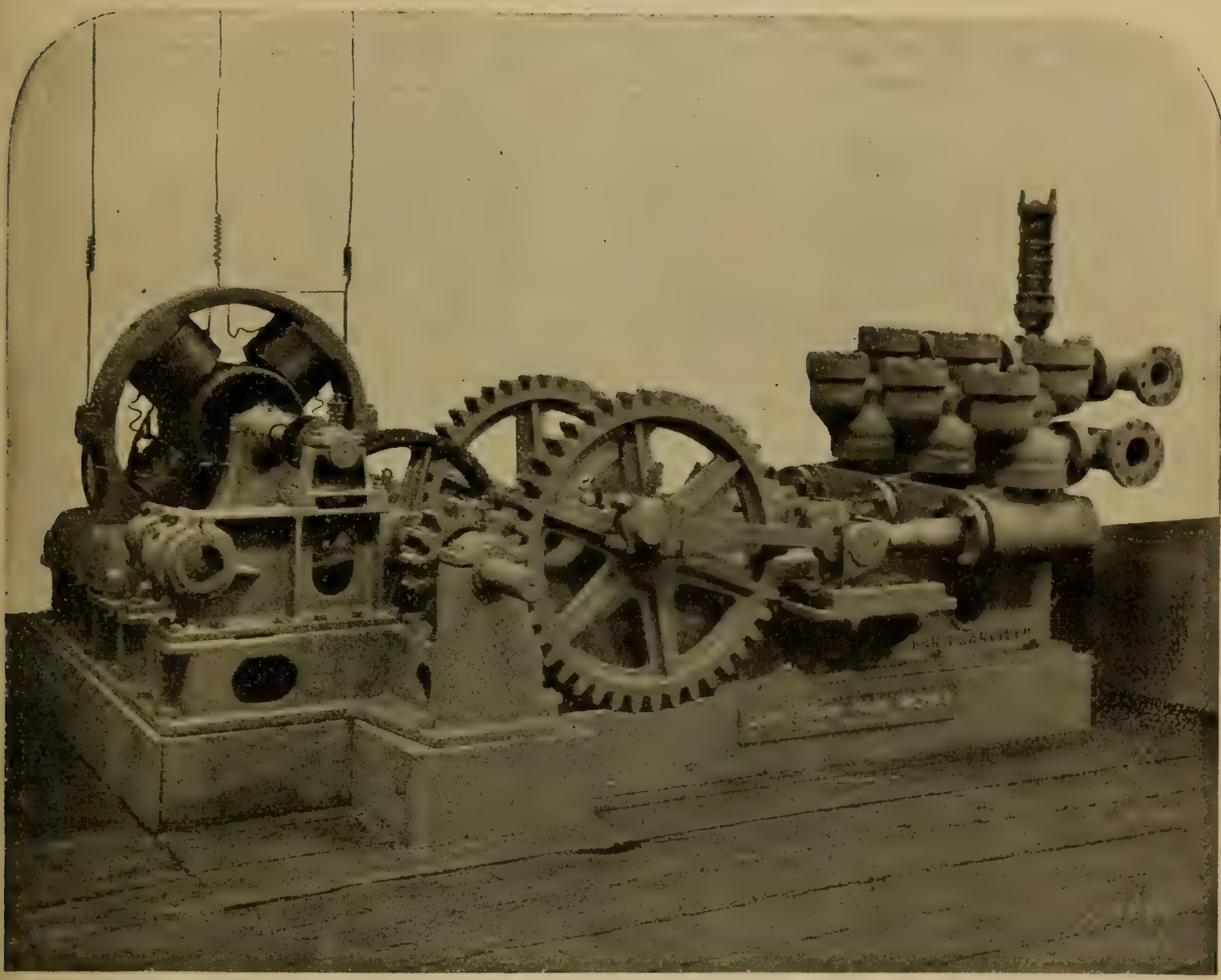
This decision by the Commissioners has not the broad application that may be inferred. Cases where an old article, device or agent are adapted to a new use without change are very rare, and the gist of the decision is seen in the term "article," meaning a substance or element not organized; for example, an ingredient in a composition, or a well-known implement or device not easily admitting of modification that will change its character.

9. Under the Act of 1836, the patentee's monopoly was not limited by his claim, but extended to the invention described, although as in *Goodyear* v. *R. R. Co.* (1 Fish. Pat. Cas. 626) such claims were given much, but not controlling, weight in determining the scope of patent-rights.

But under the Act of 1870, requiring the inventor to "particularly point out and distinctly claim" his invention, the monopoly is not co-extensive with his invention, but is limited by the claim. *Durrand et al.* v. *Green et al.*, Penna., LXVII, 814.

This is another case where there must be a limit to inference. A patent cannot be limited to its claims, because these cannot be considered in the abstract. This is proved by the claims containing specific reference to the drawings and description in the words "substantially as described," nor does a careful reading of the judge's words convey a meaning different from this, but rather that an element not embodied or mentioned in the claims cannot be included in the right conveyed.

10. The two years' public use, barring a patent, does not require the knowledge, consent, or allowance of the inventor. *Ex parte Drawbaugh*, C. A. D. C., LXVII, 929.



ELECTRICALLY DRIVEN PUMPING ENGINE.

THE DOW STEAM PUMP WORKS, SAN FRANCISCO.

We have had frequent occasion during eight years past to refer to new and specially designed hydraulic work constructed at the Dow Steam Pump Works in this City, and to the organized methods of their business, also to the wide range of adaptation carried out in their pumps for war vessels and in various permanent works of a special character.

The engraving above represents some late practice of their's in adapting pumping apparatus for driving by an electric motor, one of a number of designs recently carried out on similar lines. The present engine is adapted for high pressures up to 650 pounds per inch, or heads to 1,500 feet, the machinery being mounted on a heavy

continuous sole plate, and the framing arranged to receive a bell-crank for vertical pumps if required.

The engine shown, and others of analogous arrangement, are especially adapted for mine pumping, and plants of the kind have been furnished to the Standard Mine, at Bodie; the Gover Mine, Amador City; the Idlewild, Utica and Harqua Halla and other mines, to operate by electrical current, and for various heads and volumes of water.

The forces set up in pumping apparatus of this kind, and the constant duty, are such as to demand massive framing and connections, the best material and workmanship, all of which qualities seem to be present in recent work we have examined at the Dow Pump Works.

THE PATENT LAWS OF GREAT BRITAIN.

The patent laws of Great Britain rest upon Section 6 of the Statute of Monopolies, enacted in 1623, and yet in force. It reads as follows:

"Provided that any declaration before mentioned shall not "extend to any Letters Patent and grants of privilege for the term "of fourteen years or under hereafter to be made of the sole work-"ing or making of any manner of new manufactures within this "realm to the true and first inventor and inventors of such manu-"factures, which others at the time of making such Letters Patent "and grants shall not use, so as also they be not contrary to the law "nor mischievous to the State, by raising prices of commodities at "home, or hurt of trade, or generally inconvenient, the said fourteen "years to be accounted from the date of the first Letters Patent or "grants of such privilege hereafter to be made, but that the same "shall be of such force as they should be if this Act had never been "made, and of none other."

Extensive changes were made in 1852 and 1883, also frequent other amendments in the 272 years since the Statute of Monopolies, but the laws are very brief, plain, and have furnished a model for most other countries.

The term of a British patent is 14 years, but to maintain it there is an annual tax, beginning with the fifth year, increasing from £5 for the first year up to £14 for the fourteenth year. British patents include England, Ireland, Scotland, Wales and the Isle of Man, but no other dependency, not even the Channel Islands. There is no legal requirement for the working of patents in England, but under certain circumstances the Government will compel a patentee to issue licenses for the working of his invention.

Patents granted since 1884 do not expire with a previously-granted foreign patent, as in most other countries. Patents are granted in Great Britain directly to applicants from other countries, the same as to subjects of the Crown, or are granted to a British subject who presents an application as a "communication from abroad." The latter form is preferable in negotiating for the working of a patent in the United Kingdom. The fees are but little more in this method of procedure.

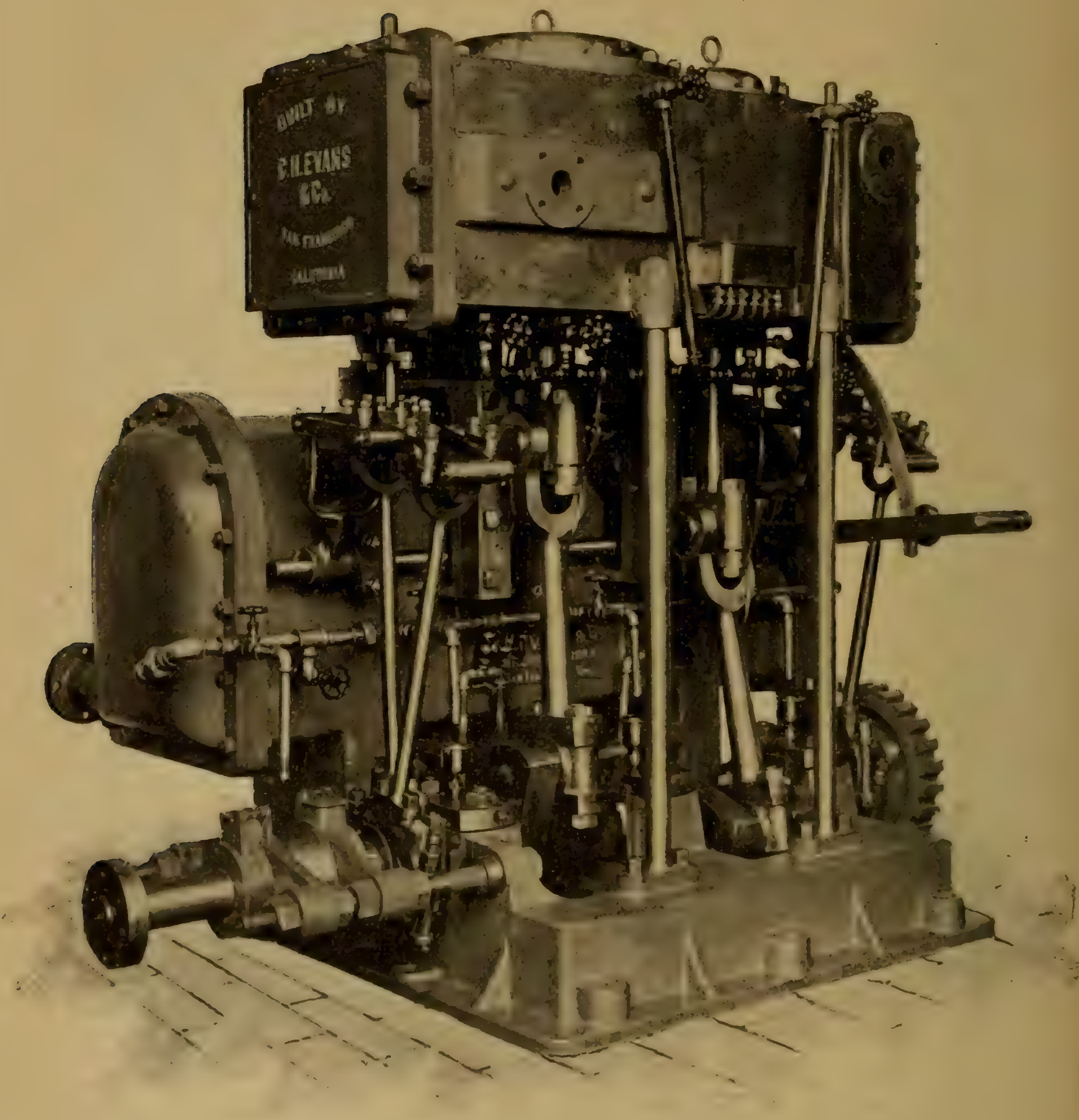
The specification for a British patent can be filed complete, or a provisional or preliminary specification can be filed, which must be followed by the complete specification within nine months. The provisional specification protects an applicant against the various circumstances that during this time might invalidate his application, such as publication in the country.

While the patent laws of Great Britain are simple, as before remarked, procedure in the various offices or departments is complicated, and requires a good deal of legal knowledge. The term inventor in the statute is construed to mean one who "brings in," or an importer, as well as one who originates an invention, consequently patents are granted to those who declare themselves in possession of "a communication from abroad."

The laws and procedure in the courts are opposed to fraudulent communications, but there being no express provision in the statute against an application made without the consent of a foreign inventor, redress in such cases is difficult and tedious, hence applications should be filed in England as early as possible.

The specifications require to be, or should be written plainly in the terms employed in that country, capable of free translation into other languages, and contain a preamble defining relations, scope and objects of the invention. The drawings should be geometrical, such as are best understood by skilled people, not artistic illustrations. The language, dress and completeness of a specification adds much to the commercial value of a patent in Great Britain, hence none but competent and reputable agents should be employed to present and prosecute cases there.

Owing to the difference in the laws, procedure, and general character of such documents there, specifications should be drawn especially for the British Patent Office. A specification originally drawn for use in Great Britain will meet the requirements of the United States Patent Office, but specifications as commonly drawn in this country are not in good form for the British Patent Office, or for procedure there in case of infringement.



COMPOUND MARINE ENGINE.

C. H. EVANS & CO., SAN FRANCISCO.

We have many times had occasion to comment upon the extraordinary versatility of the work produced in the machine works of this City. This is enabled by an exceptional experience here, when there was no division or classification of work, and does not exist elsewhere in the same degree.

In the works of Messrs. C. H. Evans & Co., for example, the main line of work done is hydraulic machinery, but some years ago when passing there, we came upon the engines and wheel gear for a stern-wheel steamboat made at these works, and now there is added the compound marine engine shown in the plate on the page opposite. The engine is for the *El Quezál*, a small vessel to be used for towing lighters and other traffic at the port of San Jose de Guatemala.

Messrs. Evans & Co. furnish the following particulars of the engine:

"The engine was carefully designed by us with the object of making it compact and durable, and easy of access to all the working parts; also to be convenient to handle, both from the engine room floor, or from the deck, by an additional lever not shown in the plate, because in that hot climate the engineer does not stay below any more than he can help. The condenser was made larger than is usual here on account of using warmer water, and was elevated a little above the bed plate of the engine so as to give good drainage to the air pump, which, with the circulating and feed pumps, are independent of the main engine, being all combined in one steam pump with our crank and flywheel movement.

"In building the engine great care was taken to have the material and workmanship of the very best, because the contract called for this, and in the second place the boat is to be put in competition with one of similar size (but slightly different design) that was built in England, and it was only by close figuring that we kept the job from going there this time, so we wanted to show that just as good machinery could be made here as anywhere else in the world, and better than is usually made elsewhere."

LITERATURE.

Those sending books for notice in this department are requested to mark in review copies the price at which the books are sold.

Compressed Air.

BY FRANK RICHARDS.

This book we have examined with a good deal of interest, because there is between the elaborate theoretical, and the plain practical application of air as a means of transmission, a wide space, here filled in by a practical engineer and skilled mechanic, or, in other words, we have here the very matter that every one interested in the subject is trying to find out.

On this Coast where air compression has a very prominent place in our industries there is a wide divergence of opinion respecting the efficiency of the method, and opinions may be divided into two classes. One that has come down from ten years ago, that the losses are about 60 per cent., and the other that since reheating, positive valves and efficient cooling, the losses are not more than 10 per cent.

The facts lie along between these estimates, and have not been so well explained before as they are in the present treatise. The author says: "I believe the best way to advertise compressed air is to tell the straight truth about it, and this I have tried to do." This is evidently done to the best of the author's ability, and his ability seems to be especially complete.

The book is published by Messrs. John Wiley & Sons, New York.

Journal of the Association of Engineering Societies.

SEPTEMBER 1895.

The present number of this publication contains the paper read by Mr. J. D. Isaacs before the Technical Society, on April 5th, 1895, on "Stopping a Slide at the Summit Tunnel on the South Pacific Coast Railway in the Santa Cruz Mountains," with the discussion that followed; also a paper by Mr. W. H. Searles, read before the Civil Engineers' Club, of Cleveland, July 9th, 1895, on "Deflections and Strains in a Flexible Ring under a Load."

Mr. Isaac's paper, which we failed to procure a synopsis of at the time it was read, is an interesting account of a difficult work performed during the wet season in a place where the rainfall is excessive and under exceedingly unfavorable circumstances.

Mr. Searles' paper is an analysis of the flexure and contour of cylindrical bodies under pressure that has its principle object in determining the loads that may safely be placed on empty pipes, deduced from experiment as well as computation.

The Journal contains the usual index to current technical literature.

Hall's Infringement Outline.

This is a treatise on patent law and procedure, directed to license, identity, validity, and recovery in patent causes, and is made up from or has its basis mainly in decisions of the U. S. Supreme Court.

It is a technical treatise in so far as that term will apply to patent law and procedure, and more than any other work of the kind that has appeared disposes of or explains the meaning of terms connected with the intricate subject dealt with. It is also analytical to an extent that indicates consummate knowledge on the part of the author, and is essentially a book for the bar. It has received commendation from the Chief Justices of the U. S. Supreme Court, who find in it a complete summary and classification of important decisions bearing upon the heads first above noted.

There is, however, one division of the work that is of general as well as technical interest, a classified reference table, occupying eleven pages, giving important decisions of the Federal Court bearing upon special subjects. The want of space this month prevents some extracts, which we would otherwise be glad to make.

The book is issued by Messrs. Banks Bros., law publishers, Murray Street, New York. Price one dollar.

California Gold-Mill Practice.

This is the title of a bulletin, No. 6, recently issued by the California State Mining Bureau, and is another commendable step in the direction of useful practical information.

It was prepared by Mr. E. B. Preston, of the staff, and is a plain description of Cali-

fornia practice, which, taking into account the economy in first cost and efficiency, is unapproached in any other country. It has come down through a comparatively short but intense period of experiment, when changes followed as rapidly as there was promise of improvement.

There are hundreds of useful facts and hints to be found throughout the work, and, outside of all technical purposes, it will fill an important place in explaining in a popular way the gold-extraction processes now in use.

The book will be sent to any citizen of California who will apply to the State Mineralogist, Mr. J. J. Crawford, State Mining Bureau, 24 Fourth St., in this City, remitting the return postage, which is three cents.

Forestry for Farmers.

The Chief of the Division of Forestry, B. C. Fernow, has issued from the Agricultural Department, at Washington, a bulletin under the title above that will prove of much use in timber culture, a matter of which very little information exists in this country.

There are numerous diagrams and drawings to render the subject clear, and as such culture in this State is becoming more and more important, those interested should procure copies by addressing the Department at Washington. The bulletin is a reprint from the year book of the Department of Agriculture.

Contractors' Methods.

THE MACHINERY AND APPARATUS EMPLOYED ON THE CHICAGO DRAINAGE CANAL.

The Lidgerwood Manufacturing Co., of New York, have published a neat album filled with plates showing the novel apparatus employed in excavating the great Chicago Canal; also containing a brief but comprehensive description of this remarkable work.

The Lidgerwood Company designed and constructed a great share of the machinery and devices employed for this work, and have attained results therewith that far exceed any previous performance in the same line.

There are about twenty excavating or handling plants along the line, the aerial tackle removing up to 600 yards for each line, and the traversing and swing machines up to 1,000 yards per diem. A saving of $1\frac{1}{4}$ cents per cubic yard in the rock excavated amounts to $150,000.

The pamphlet contains a complete history and description of the whole work, and is a very interesting publication. Copies can be procured from the Company by application in New York, Chicago or Boston.

Journal of the Franklin Institute.

NOVEMBER 1895.

The present number contains a paper of great value by U. S. Assistant Engineer A. S. Cooper, on "Tests of Mortar Mixed with Various Kinds of Sand." The experiments are extensive and exhaustive, and should engage the attention of architects, and civil engineers.

A second paper of interest, and perhaps of alarm, is one by Dr. M. V. Ball, on "Bacteriology in Relation to Food," indicating, as is the fact, that in this science we are only at the threshold, yet far enough to discern mysteries that the world never suspected.

There is also a paper on "The Growth and Sustaining Power of Ice," a curious subject, extensively treated by P. Vedel, C. E., and an essay on "Bitumen" by Mr. S. F. Peckham.

Consular Report, No. 181.

OCTOBER, 1895.

Want of space compels us to pass over this issue with the remark that one of its most interesting sections is a communication from U. S. Consul Doederlein, at Leipsig, on "Electric Plowing in Germany."

The communication is accompanied by a number of illustrations, and the Consul has in answer to a request by the State Department made a full and able report, but its value is of doubtful utility. Of course the electric elements have no required function, except the "conveyance" of power, and to attain this introduces a complicated lot of detail that would never be tolerated in this country. The conductor requires as much apparatus for its care and support as a pneumatic tube, and the latter would on many grounds be preferable. Power-driven plows will, if ever employed in this country, no doubt be on the auto-mobile principle.

LOCAL NOTES.

The Ship Owners' Association, of this City, last month, addressed a communication to the Manufacturers' Association asking that a committee of that body be appointed to meet and confer with a similar committee of the Ship Owners' Association and other commercial organizations to consider means for reducing port and other charges on shipping. Such a committee has been appointed, and Mr. G. W. Dickie being a member of it we think some light will be thrown upon the antiquated injustice of port charges against vessels that pay "land taxes." It is a subject with which Mr. Dickie is wholly familiar, and one he has for a long time taken much interest in. Mr. R. S. Moore, of the Risdon Iron Works, Capt. W. L. Merry, Mr. J. N. Knowles, and other men prominently interested in shipping, compose the committee of nine members. A meeting, noticed in another place, was held on the 8th of November.

There are certain branches of the mercantile importing business here that deserve every encouragement, because supplementing and rendering possible the local industries of the Coast. One of these is the machine supply business, consisting of hundreds of articles that cannot be made here, and still must be kept at call. This fact came to mind recently in looking over the warerooms of the Pacific Tool and Supply Co., in this City, where there is kept on hand a stock of implements and supplies that would be superfluous in any large Eastern city, or elsewhere near the source of production. Cutters, drills, taps and dies, gauges, reamers, chucks, small machine tools, and a hundred more things that would otherwise have to be kept on hand in the various works are assembled at this central station, it may be called, and in this manner arises a great saving. The Tool and Supply Co. have from time to time extended their room and stock, until it is now certainly ample for all requirements of the trade.

Chief Engineer J. W. Moore, who has so long been in charge of the steam engineering department at the Mare Island Navy Yard, has been retired, and this department has been placed under the charge of Chief Engineer Geo. Kutz, also well known on this Coast as an able officer with wide experience. Chief Engineer Moore will leave behind him many warm friends, who will remember his quiet unobtrusive service to the Government during a period when at an advanced age he was called upon to follow a complete revolution in steam engineering. He has well earned his rest from active duty. Chief Engineer Kutz represents whatever is advanced in the mutable art, but will, we imagine, be called upon in the future as in the past for duties much wider than management of the engineering department at the Mare Island Navy Yard.

We have remarked a good many times upon the leather belt manufactures of this City, the gradual extension and permanence of the industry, and have just gone over the works of the H. N. Cook Company, to find the premises extended and improved with various new machines added to the manufacturing plant and signs of activity throughout. There is a permanency about leather industries everywhere, but on this Coast, either from the enterprise of owners or some local advantage we do not understand, they manage to "keep in front" both as to processes and product. A member of the H. N. Cook Co., who has just made a tour of the Eastern States, claims that the practice here is quite abreast with anything he met with elsewhere, and one must note that amidst all the cry about hard times, many if not most of our local industries have been extended and improved. Perhaps lower profits demand extension of trade. If so, it is not wholly a misfortune.

In the present and in some future numbers of "INDUSTRY" will be given short synopses of the patent laws and procedure in various foreign countries where it is common for American inventors to apply for patents. These articles will at the end be republished and preserved, so as to form a convenient reference for those interested in foreign patents. The object will be to answer in this manner frequent inquiries made for such information, and avoid the difficulty of answering such inquiries in a satisfactory manner within the limits of a letter, also to take note of changes made in the laws of various countries during recent years.

Mr. L. R. Mead, Secretary of the Manufacturers' Association, while driving some friends across the country near his grounds, Byron Springs, Contra Costa County, was "brought up," by the following notice posted at a gate:

"Shut the Guete elf you plis, cause the horses arrivest in the stack, hay and wheat. P. S. & Co."

Mr. Mead copied this struggle with the subtleties of English "as she is spoke," and sends a copy. Perhaps some person can guess the nationality of the author.

The Welsbach gas burners have by accounts become a rival to electric lights at San Jose in this State. Mr. Randall, of the Pacific Coal Gas Association, introduced these new burners there, and has had a good deal of amusement as well as some success in competing with electric lighting. His plan was to substitute free of cost to the citizens Welsbach lights to replace electric ones, with the agreement that any saving in expense should be applied in paying for the gas fixtures, and claims that in some cases such fixtures were paid out the first month. This is a curious circumstance of which we hope to hear more in future.

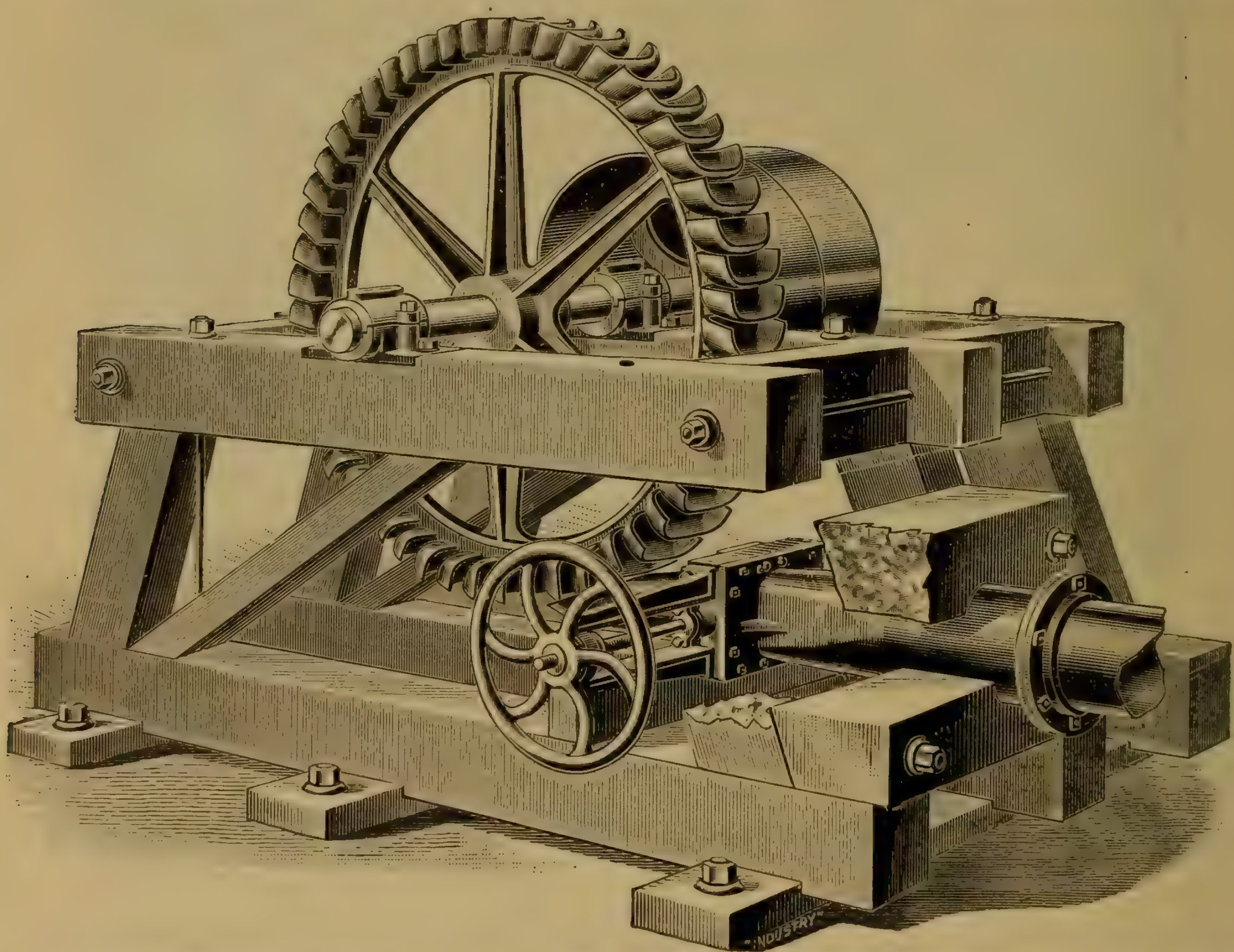
The Rev. Richard Wylie, of Napa, Cal., who has interests on Clear Lake, being the owner of the Soda Bay property, has written an article on the subject of the effects that may result from a utilization of the outfall water for power, showing how in that case the lake might be maintained at a more uniform level. This will certainly be a result of any expedient or method of using the water for power, but that consummation is, we imagine, not very near at hand. By enlarging and straightening the level outfall at the bottom, and providing for the escape of flood water as well as retaining the normal volume, Mr. Wylie shows how all the riparian interests around the lake shore will be served. This is certainly correct, because the fluctuation of water level in this as well as other mountain lakes is a most undesirable feature, widening the neutral shore and baring saturated areas in summer.

Last month there was a raid on the milkmen of San Francisco, the City inspector condemning and turning out a good share of the supply in some cases, mainly because of water admixture, and worse, but the question is, what is this for? If a purveyor's milk and water are turned out by the inspector, then more water must be added when the inspector is gone to make up for the spilled milk. As to convictions, fines or punishment of the milk-vendors we hear nothing, so infer the proceeding is under a law without penalties. Spilling the milk inflicts no punishment except upon the expectant purchasers, who must drink black coffee. Every one is in sympathy with a reform in this matter, but the method of it is theatrical instead of effective.

The Union Iron Works have removed their City office to 222 Market St., and have fitted up commodious quarters, with lights on two sides, the Siemens & Halske Company having space on the lower floor. The offices are in every way an improvement, and hereafter will be more an administrative than an executive head of the business. Extensive executive offices are to be erected at the Potrero, outside and opposite to the works, so as to permit the present office room to be included in the fitting floors. The latter have to be much extended besides this, and in the near future the Union Iron Works will be one of the best arranged of the kind on this continent.

The American Society of Mechanical Engineers will hold their sixteenth annual meeting in New York City, December 3d to 6th next. This will be the most notable and extensive meeting ever held, owing to the central position, the environment, and the fact of being the home of the Society; and their own building available for sessions and other uses connected with the convention. The papers to be presented, thirteen in number, embrace various engineering subjects of interest that we have not space to print a list. One by Prof. W. F. M. Goss, on the de Laval Steam

THE KNIGHT WATER WHEEL



The drawing above shows one of Knight's Standard Water Wheels, of which there are more than 450 in use in California alone. These wheels are made from 2 feet to 6 feet in diameter, from 10 to 1000 horse power, and adapted to all heads and to all purposes. Their first cost is less than one half as much as pressure turbines, and the expense of maintenance is not one fourth as much. Circulars with full description and particulars sent free.

KNIGHT & CO.

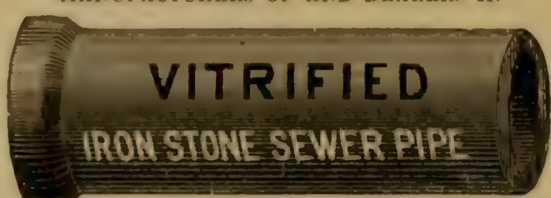
SUTTER CREEK, Amador County, Calif.

RISDON IRON WORKS, San Francisco Agents.

N. CLARK & SONS

MANUFACTURERS OF AND DEALERS IN

CAPS AND TOPS



FIRE BRICK AND FIRE CLAY

Water Pipe **Chimney Pipe**

17-19 SPEAR ST., SAN FRANCISCO

Turbine, will be of especial interest, and of which we will give a synopsis in due time. Visits will be made as usual to various works and places of note about the city, and two thirds of the return railway fare will be remitted to members attending the convention.

The Parrott Building, in this City, now nearing completion, is one of the most notable structures of its class here or elsewhere. We mention in another note the electrical equipment to be furnished by the Union Iron Works and Siemens & Halske Company of America, this will indicate the extent of the building, which is to contain more lights than any other business building in this country, except the Auditorium in Chicago, also equipped electrically by the Siemens & Halske Co., in 1894. There will be 350 arc and 5,000 incandescent lamps, also fifteen electrically operated elevators, requiring six 100 kilowatt generators, each driven independently by vertical compound condensing engines. The steam power will in all exceed 1,000 horse power, to be generated by internally fired boilers, operating on the Howden system. The machinery fitting of this immense building will far exceed in extent any contract of the kind ever given out on this Coast.

COMMENTS.

The New York *Sun* is credited with the following bit of economic twaddle:

"Legislation can make any kind of a dollar of equal power 'in the payment of debts' with every other dollar. All through the war, and for many years afterward, it made a paper dollar worth from 40 to 75 cents, according to the fluctuations of the day, just as good for debt-paying purposes as coin."

The paper dollars had no value to pay for anything, except as they were convertible to money having intrinsic value as their face declared, and no paper dollar can on other grounds have value beyond the paper it contains. The problem that determines its value is, will it be paid? The power of the Government can do nothing in the matter unless it be to force people to receive such paper in payment of created debts, or steal from the people, which is the same thing, but business does not relate to existing debts, so much as to future contracts, and no power of government can dictate what a person must "agree" to take as a consideration.

The Bureau of Statistics, at Washington, has issued a bulletin giving wages in foreign countries, that is the rate paid to workmen, which is of doubtful utility. The "rate" of wages is a meaningless quantity. The true economic problem, the thing we are desirous to know, is the "amount" of wages that enters into commodi-

ties. In California forty years ago a carpenter was paid $20 to $25 a day, and did not get rich at that rate. At present a carpenter here at $3.00 a day builds a house cheaper than one at 30 cents a day in Japan. The "rate" of wages is a matter of no economic concern. It is a social problem.

The Government advertised last month for tenders for two battle-ships, Numbers 5 and 6, the bids to be opened on the last day of the month. The Government is to furnish armor and armor bolts for all except the decks, and material provided by the contractors is to be of domestic manufacture. The vessels must run for four hours at the rate of 16 knots an hour, and for every knot less than this the contractor is to be fined $100,000, and if the speed attained is less than 15 knots the vessels will not be accepted. There are no premiums offered for excess of speed, a method that is open to abuse. One of these vessels is to be constructed in or near the Pacific Coast, unless the President decides that bids from here are extortionate, in which case he can let the contracts to Eastern builders, and in view of such an emergency contractors are invited to tender for both ships. Three years' time is allowed for construction, and there is little doubt that one of these huge vessels will be built here at San Francisco.

In the exports for the year there will appear a great increase of machinery and agricultural implements. In the first eight months the machinery sent out was about $7,500,000, and of agricultural implements $4,500,000. Copper products increased from $252,000 to $818,000 over last year, and there has been a corresponding increase in carriages, watches, clocks, paper, hemp goods, instruments, hardware, locomotives, sewing machines, boots and shoes. This we believe to be mainly a result of lowering the tariff rates and cultivating a friendly feeling in our commercial connections. Our exports for some reason have a marked effect upon prosperity, and they will increase regularly and greatly so long as there is not a "boom" to increase the price of material, or a new scale of customs to do the same thing. What commerce needs is permanence in prices; fluctuations stop all.

The newspapers last month stated Mr. John Jacob Astor had espoused faith in the Keeley motor, and taken up its defense, manufacture, or something of the kind. This is no doubt very satisfactory to Mr. Keeley, because Mr. Astor is reported to have a great deal of money accumulated in a very easy way, mainly by the energy and industry of other people, and the motor business is expensive. There is only one disposition of the matter more desirable, and that would be to have a citizen of some other country assume the responsibility, and if possible move Mr. Keeley out of this one. He has succeeded in drawing upon the American people the ridicule of the world, and has now had twenty years of such use

of the national reputation. Switzerland would be a good country to move to, that is good for the people who invest in the motor, but it would be hard on Mr. Keeley, who would run a good chance of having to explain his invention in a law court.

When the contract with the North American Commercial Co. was made in 1890 for the use of the sealing grounds on the Pribylov Islands, we predicted there would be some impediment arise to collecting the rental and tax on the skins. The rental was increased from $35,000 to $60,000, and a tax of $2.00 was to be paid on each skin sent out from the Islands of St. George and St. Paul, and 50 cents a gallon on the seal oil obtained. The sum now due the Government on this contract exceeds $200,000 down to April 1st of this year, and the U. S. Attorney-General has brought suit to recover the amount. The grounds of non-payment are no doubt a failure to protect the seal fisheries, but there were taken during the year preceding 16,031 fur seal skins. It is the old story, common to all, contracts between the Government and private firms or companies.

The Sonoma *Democrat*, of November 2d, has an editorial on "Russian Diplomacy" in the late war between China and Japan, that contains much serious matter, ascribing the onus and animus of the war to Russia, who is to be the beneficiary of this barbarous conflict. The indemity paid by China was a Russian loan, at four per cent., of 400,000,000 francs or $77,200,000, made up from six French and three Russian banks, but on the account of Russia, because that government guarantees the payment of the bonds, and the interest also. The treaty between China and Russia, the main outcome of the war, gives the latter power "anchorage in Port Arthur," which, as the editor of the *Democrat* assumes, amounts to a clean title to the port, also the right of way for the Siberian Railway through Manchuria, a densly-populated Chinese country, to the Sea of Japan, giving to Russia an outlet to warm water in the Pacific Ocean. We cannot agree with the *Democrat* in this agrandizement. It looks more like a logical necessity for Russia.

The Protective Tariff League some time ago applied to Mr. David Lubin, of Sacramento, Cal., to contribute to its funds, and Mr. Lubin, whose views we have frequently set forth in "INDUSTRY," promptly sent his check for $1,000, but awkwardly attached a condition, that before the check was paid, an impartial committee should decide that the present system of protection is just to farmers. The Protection League could not manage this it seems, and declined the contribution, but the California State Grange has taken the matter up, and are "pressing for a solution," so also are other farmers' associations that contend as Mr. Lubin does, that if there is a protection tariff on imports there should be a bounty on agricultural exports. Mr. Lubin, no doubt, very well knows that it is just this

inequality that is sought, and that any system of impost and bounties that bear equally on people's interests would be a farce, and only an advance of prices all around.

Mr. Chauncey Depew, who is at the head of what may be called rhetorical humbugs, has discovered as follows: "That the whole of the tonnage on the oceans of the world last year was about 140,000,000, while the tonnage of the railways of the world carried one hundred miles was about 1,400,000,000." The listeners to such twaddle were of course astonished, and did not notice that a distance measure was applied to the railways only. Very little freight is carried at sea so short a distance as 100 miles, and a reduction to such a measure would increase the ocean tonnage ten to twenty fold. Not only this, ocean tonnage means real commerce, while much of the railway carriage is merely internal shifting of things, and is not comparable. But the statement is, no doubt, on a par with some other fancies of the great man, without any foundation in fact, or intended to have.

Senator Lodge, of Massachusetts, last month formally declared war against Great Britain over the Venezuelan boundry matter, and being on the enemy's ground it is to be hoped he will take the matter in hand and conduct the whole business. We are unable to see how a war could settle the right and wrong of the matter, or of any other matter, and must heartily endorse the following sentiment and opinion found in one of our Eastern exchanges. "We need more men in public life and on the press who seek National greatness in the sphere of mind and law, and resist the longing for bloody corpses, desolated towns and the general hell of death and destruction, called war." To any one who has seen war, its demoralizing influences and the curse of lawlessness, dishonesty and selfishness it entails on a nation, there arises the suggestion that whoever shouts for war should be instantly taken out and shot.

Engineering Notes.

German engineers and mechanics seem to have gone into the subject of rolling out forms in metal in a very extended way. The Manesmann tube rolling machines are one of the greatest novelties of our time, and now the chain rolling machines seem to have got on a commercial footing there. To roll out a chain from a bar of metal of a cruciform section is a mechanical feat of the highest class. How it is done cannot be described, and scarcely shown by drawings.

The General Omnibus Company, of Paris, a very large and rich corporation that controls the street traffic there, has been much

extending the compressed air system, and now employs it on twenty-four miles of line, or will as soon as details are completed for recent extensions. The cars hold 51 passengers each, the locomotives weigh 18 tons, and haul three cars, and work up grades of four per cent. Two of these lines make up 1,156 train miles daily, and the air system is no longer an experiment. At Nantes, in France, the same system has been in use for fifteen years, and the result "figures out" very satisfactorily. There are also other lines of the kind in France, one at Nogent, working at an expense of about 12 cents per car mile. At Paris better results will be attained, because of a heavy traffic that permits larger investment and more perfect machinery.

In the history of the great religious war of Europe, when Gustavus Adolphus, of Sweden, led the Protestant forces until he lost his life at Lutzen, there is an account of cannon bound with rawhide. This fact, read by thousands, no doubt, has appeared to every one a kind of "fish story" of an incredible kind. We can recall one instance when this matter was related by a Swede in a company of people well informed in mechanics, and one of the hearers afterwards saying: "Well, I draw the line at leather guns." Now, however, this invention has come back again to revisit the earth after a period of 250 years, and has just been tried on the proving ground at Sandy Hook, New York, where a rawhide gun of 2½ inches bore withstood a strain of 30,360 pounds per square inch. There was an inner tube of steel ¾ inches thick, reinforced by raw-hide one inch thick at the muzzle, and three inches thick at the breech.

The Germans in their methodical way have been trying a large number of oil engines of different makers with the result of about one pound of oil for each brake horse power per hour, and the utilization of about 12 per cent. of the thermal units contained in the oil. This is a rough average of twenty-five different engines, and indicates the present state of the art in Germany, where we naturally look for the best results with the internally-fired type of engines. There is not much to boast of, however, so long as 87 per cent. of the heat escapes without returning energy, but this method of estimating is a laboratory one, and not so good as to compare with a possible standard as in the case of steam engines. The reduction of these experiments to graphic form forms an interesting study. It includes all the various resistances and losses plotted in a careful manner.

We now-a-days find frequent dissertations on high speed in turning, planing and boring metal, speed of tools we mean, and generally from men who do not themselves do the cutting. The first thought of an inexperienced person on seeing a lathe or a planing machine at work is: "Why is there not several tools at work instead of one?" The idea of high-cutting speed is much the same, and

a much better standard is to weigh the chips and let the cutting man have his own way. Rapid work is the result of a good many components besides the rate of movement, most of them mysteries to the unskilled who see nothing but "speed." The most rapid planing and turning are done at comparatively low speeds, 16 to 20 feet per minute, and sharp pointed tools with fine feed have no chance in a race against the heavy cut and moderate speed. This remark, of course, does not apply the same to cases where temperature is kept down by a stream of water, but even then the true limit is often exceeded.

The engines of the new gunboats, two of which are to be constructed at the Union Iron Works, will be of 2,000 horse power when running at a speed of 412 revolutions per minute. There will be four cylinders for each engine, two low pressure making triple expansion. The frames are of steel, and the most notable point seems to be an extraordinary valve and port area; in fact the valve and piston of a modern high speed engine are becoming near the same size. The boilers of the gunboats will be of the coil type, a "kist o' pipes," as the Scotchmen say, disposed in a rectangular furnace or case, and strong enough to sustain a working pressure of 250 pounds per inch. All the fittings and steam containing parts, except the boilers, are to be tested to 500 pounds per inch. The trial runs of these boats will be a matter of more interest than those of the cruisers or battle-ships.

The miners' inch of water, or the common measure here in California, seems like a good many other things of a local nature, to be derived from the Mexicans. It is a simple method that does not involve the element of time in determining quantities or use. The names given to apertures were the *paja*, *dedo*, *real*, *naranja*, *surco* and *buey*. The naranja was 4·59 feet per second; the surco, 13·8 feet per second; and the buey, 661·2 feet per second. The buey is the same as a vara, 33 inches. These measures for running water were based on a flume of the dimensions named, flowing full with a fall of one pulgada (·916 inches) for every 6 varas (16·5 feet) or about 5·5 inches in a hundred feet, the miners' inch has no doubt this derivation.

One after another large fly wheels are wrecked, and with them nearly always life and property are destroyed. The accident at Hoboken, N. J., in October, has been described in *Power*, which says the method of fracture shows good design of the wheel, and that no blame is ascribed to the makers. Perhaps not, but from an examination of the drawings, we conclude that while the wheel may have been good of its "kind," the kind is not safe and should not be permitted. There is no need of making such wheels of bolted up segments of cast iron, held by cast-iron spokes. Few wheels of the kind, 17·5 feet in diameter, would have held up to 200 revolutions as

is claimed, but one of fibrous material, such as those designed by Mr. Cobb, of this City, would not have been affected by the speed. Then again, a pair of large Corliss engines of 500 horse power should not be so geared as to run away. We once saw an old factory engine rigged with a rope extending up through several floors, that would pull off the cam hook. This engine never got away.

We have received a prospectus of the Wave Power Air Compressing Company, of this City, containing drawings of the proposed system of operating. There are various officers of the company named, but not an engineer. If this function had been included we would have sent for some information. The scheme is a buoyant platform or raft, communicating its vertical movements to air compressing pistons in a number of inverted cylinders set over and around the float. It seems to be the old idea of a wave motor, that of computing "movement" when none will result. A few pounds of pressure against the pistons or in the receiver will hold the float permanent, some air might be sent ashore at low pressure, but the resistances and aggregate of possible piston movement would limit this to about enough to blow a church organ.

In Paris, the home and birthplace of bitumen pavements, and in Berlin, Germany, there has been a great change in the method of laying the material, which is no longer "smeared on," but is laid in blocks of "compressed" asphaltum, the top edges of which are champered so as to produce deep corrugations. In Berlin there is now laid more than a million square yards of such pavement, which is considered in every way superior to the plastered surfaces as formerly made. The blocks are pressed by powerful machinery at two operations and become so firm as to resist the heaviest traffic in business streets. The covering, or blocks, are laid in a stratum of hydraulic cement and vary in size according to the requirements of the traffic.

American mechanics are likely to keep up in the power driven vehicle business. It is said that in three months past 150 patent applications have been filed at Washington, for improvements in "horseless carriages," which "name" we hope is not written in any of the specifications. It is not unusual in this country to lose by tardiness a great advantage in this way, permitting foreign inventors to file applications for patents in advance, leaving our own improvements tributary. The de Laval and Parsons steam turbines are examples of this tardy method. Anything of the nature of contriving or mechanism goes ahead at a rapid rate here, but inventions of an abstruse nature requiring scientific treatment and analysis, sometimes lag behind, either in invention or application, or both. We are not very sanguine believers in motor-carriages, which are subject to some of the infirmities of aerial apparatus.

The *American Machinist* describes the effect produced on some sheet rolling machinery by the application of roller bearings, the friction being reduced to less than one half as much by this expedient, which is no doubt correct. Pressure rollers, however, are not comparable with ordinary machinery. The necks or bearings are very large in proportion to the rollers, and the frictional result is like dragging a weight on a plane. Instead of being, as is common in well made machinery about ·05 per cent., the figures are reversed, and the friction is often 50 per cent., as in the case above referred to, but as soon as the limit of pressure is exceeded, and perhaps without that, the rollers will pulverize the bearings. In another case mentioned, 104 soft metal bearings for a line shaft were substituted with rollers, causing a saving of 17·55 per cent. in friction. If the old bearings had been pivoted and made of cast iron or other hard material, and the shaft lined up, the result would have been different, no doubt.

Jet propulsion has now settled down to a fact. Messrs. Thornycraft, and Mr. M. W. Ruthven, of London, have constructed "hydraulic recoil" boats of small size, one for the government of Holland and one for the home government. One boat was of 220 and the other 101 horse power. The Ruthven boat shows about double the efficiency of the Thornycraft one, which was rigged with a centrifugal pump, discharging water backward and forward at the sides of the boat to go ahead and astern, and is rather awkward looking to come from a firm of so much experience. The suction force, which is considerable, is normal to the course of the boat, and is lost, which may account for the low efficiency. The Ruthven boat was differently arranged, but on what method we cannot now recall.

We much regret the want of space this month to reprint from *Engineering*, London, No. 1,555, an editorial on the late international yacht races, or rather on the yachts. It is the first time we have seen the subject dealt with in a manner to throw any light on it, and one reflection that comes up in this connection is that all the newspaper matter printed about the yachts is in no way worth reading. *Engineering* says there is little hope of British yacht builders winning these cup races under present methods, and gives the reasons for such belief, according to the American builders a superior ingenuity in most things, and points out in proof of this the difference in the vessels built here and in England; also remarks upon the skill of the Herreshoffs shown in the late yachts that have contended. Speaking of "Nat" Herreshoff, the editor says, he was raised a yachtsman in his young days, then trained in a scientific school and afterwards went through an apprenticeship in the Corliss Engine Co's Works, at Providence, R. I. He is therefore a salt-water man, a scientific man and a mechanical engineer. His boat was made of bronze and aluminium; the British one of steel and wood.

The velocipede movement continues. It has become a great fact in industry and economics. The sales for the past year will be half a million, with promise of increase for the future. The history of velocipedes dates from the flexible tires, or their adaptation to common roads. Previously they were a toy, now are a permanent part of our "institutions." Last Summer, Prof. Smith, of Stanford University, took a run to San Diego and back, nearly 1,200 miles, and not content with that, then went up the Sierra Mountains. The greatest effects produced in an economic way is that on livery hire, the consequent decline in the value of horses, and the consumption of gutta percha. The consumption of the latter for tires it is claimed will reach $5,000,000 for last year, and as present sources are limited, a great advance in prices must result. There seems to be no substitute. The period of resilience in a flexible tire becomes a limitation of speed. There is also a life limit of flexure for all other kinds of material.

A dredging machine, or vessel to excavate in the channels of the Mississippi, has been constructed at Cario, Illinois, that dwarfs all precedents in this line. The machinery alone weighs eight hundred tons, and the aggregated power on the vessel is 3,000 horse power. There are six harrows or disintegrators six feet in diameter, to stir up the sand, which is to be discharged by two centrifugal pumps of 36 inches bore, and the estimate of capacity is 6,000,000 gallons per hour, or 100,000 gallons per minute, which is about twice the real capacity by all rules with which we have any acquaintance. The sand or spoil is to be carried off 1,000 feet with pontoon pipes, as is done here in the Bay. The fault of the scheme, aside from a possible failure to pump sand at all, is in the immensity of the apparatus and the integrity of the whole depending on each part. The contract price of the machine is $175,000, and a possible 50 per cent. bonus for performance, which need not be much considered. We have had some experience in this line of work, and regret to prophesy a failure of the whole scheme.

ELECTRICITY.

The Jandus lamp, a new arc light invention, described in our foreign exchanges, gives promise of a great advance in street lights. The carbons last 200 hours without attention, and the lamps can be supplied from either a direct or alternating current. It is said that these lamps have been in course of experiment for eight years past, and that the sum of $150,000 has been expended on the invention, which seems doubtful. The carbons are consumed at the rate of only 30 feet, compared to 563 feet under the old system. The lamps are enclosed, but not hermetically, as an incandescent one is, because permitting access to the carbons, but when in use are in an air-tight

case, and besides the contact or arc is in a small luminous globe, open, however, to the outer or air-excluding case. The lamps are now made at the rate of forty a day in London. Since writing the above we called on Mr. A. E. Brooke-Ridley, representing the Siemens & Halske Co., in this City, and find that lamps the same as those above described are not only a regular manufacture in this country, but are in use at the Occidental Hotel and elsewhere in this City. They are also to be used in the new Parrott Building here.

The Westinghouse Electric Company sent out last year about 25,000 horse power of electric apparatus, and with the addition of the locomotive branch, and the extension of their works, expect to much exceed this for the next year. The engineer and other officers of the Pennsylvania Company have been visiting the Westinghouse works to examine the "button conduit" system for electric railways, supposedly with the object of adopting the method on some of their short lines. In the race between the Westinghouse Co. and the General Electric Co., the former seems to devote more attention to the engineering details, and their staff is technical rather than commercial, at least the work of last year permits such an inference.

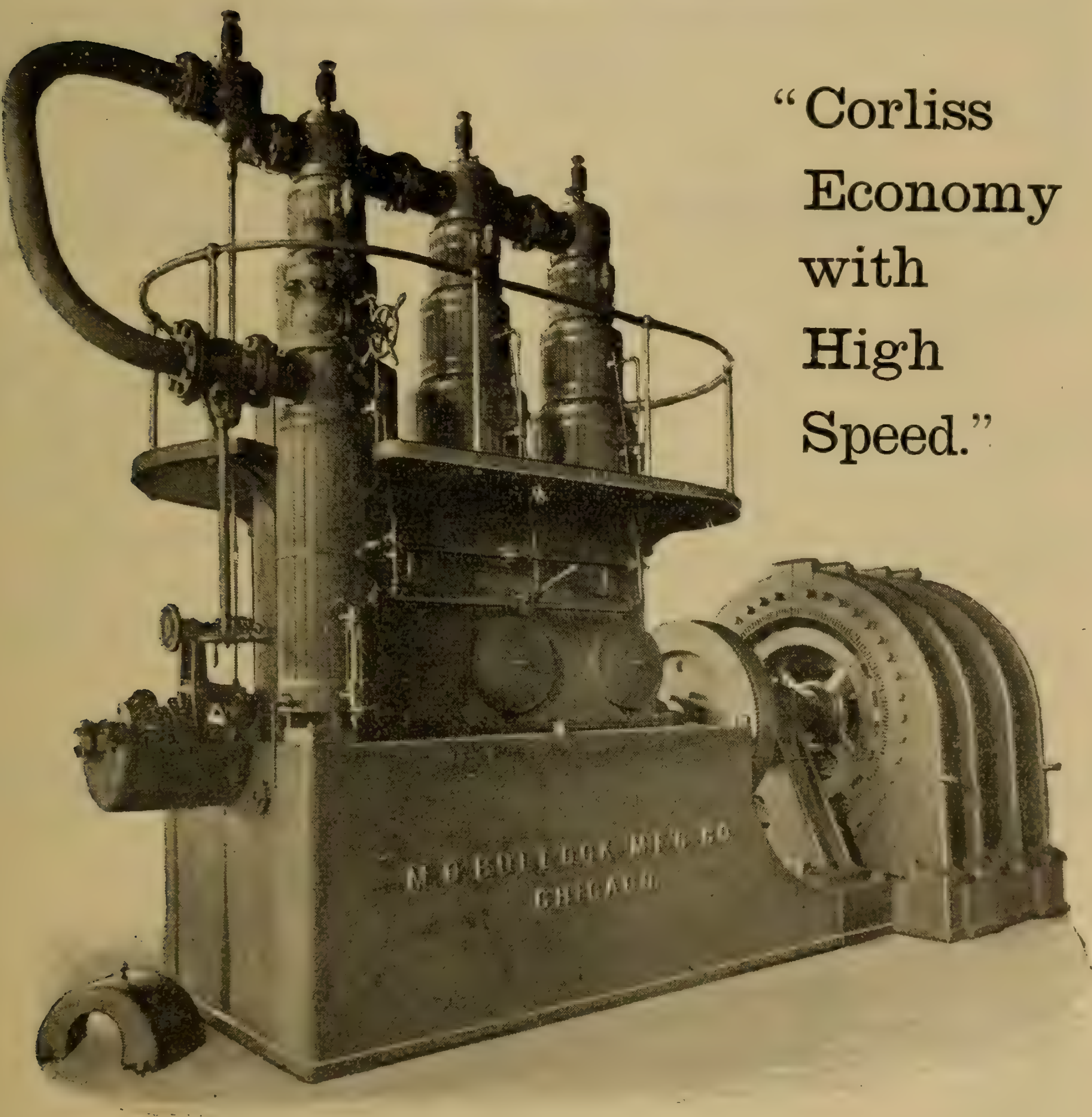
The Wheless-Westinghouse system of electric railways is receiving a good deal of attention abroad. The current is taken up from buttons beneath the cars that are connected or energized only while the car is passing over them. This dispenses with the overhead trolley wires that take from 500 to 600 square feet of section from street space, and are a nuisance in the crowded portions of cities. This new system can be applied on a line in places where the overhead wires are especially objectionable, and the trolley system substituted when the suburbs of a city are reached. The contact points or buttons are energized in some manner by apparatus on the car, and it is claimed no danger can occur from the feeders or main lines.

The Hoosac Tunnel is four and a half miles long, and it is said no iron ore or other metallic mineral was encountered in making the tunnel, but an electric current cannot be sent through it, so the telegraph wires have to be placed overhead on the surface, nine miles, to communicate from one end of the tunnel to the other. This is a very extraordinary matter, and it would be a subject of interest to know if conditions of the kind have been observed elsewhere, and if not, what are the circumstances that absorb or dissipate electric currents in this case?

TRACY, STARKWEATHER & TRACY.

220 Fremont Street, San Francisco.

ENGINEERS.



"Corliss
Economy
with
High
Speed."

The above illustration is of the seventh **WILLANS' ENGINE**, installed by the Citizens Electric Light Co., of Terre Haute, Indiana, and since its installation in June has run 167½ hours each consecutive week, according to contract. This service is required throughout the year.

Nordberg-Corliss and Poppet Valve Engines and Cut-Off Governor.
Willans & Robinson Central Valve Engine.
Hawley Down Draft Furnace.
Shawhan-Thresher Dynamos, Motors and Electrical Apparatus.
Milwaukee Boiler Co.'s Steel Tubular Boilers.
Lucas Slide Valve Engines, Boilers and Power Feed Pumps.
Tracy Cooling and Condensing System.
Prescott Boiler Feed, Fire and Mine Pumps
Mosher Steam Separator.
Water Tube Boilers.
Siphon and Surface Condensers and Air Pumps.
Gas and Gasoline Engines.
Centrifugal Pumps.
Open and Closed Heaters.
Automatic Feed Regulator.
Perfection Draught Regulator.
Manville Sectional Steam Pipe Covering.

Catalogues and Information on Application.

MINING.

NOTES.

The gold-bearing district at the Witwatersrand, Africa, is estimated by American engineers at 50 miles square, the deposit 1,200 feet deep, and to contain one and a half billions of gold. The product at this time is given at $3,500,000 per month, or $42,000,000 a year, which certainly warrants some excitement in the share market. The number of people now employed in the Witwatersrand is fifty thousand Kaffirs and eight thousand Europeans, which is an inconceivable number. The district has been examined by Dr. Schmeiser, an eminent German mining engineer, and by Mr. Hamilton Smith, from this country, who it is said is in the employ of the Rothschilds, the great money firm.

The people of British Columbia have been industriously and reasonably attempting to divert some of the British gold now going into African mines to their country, and will no doubt succeed. The capital now interested in mines there is to a great extent from this country, especially in the Kootenay district, and this should give assurance, because it is the work of many men, and not a stock jobbing venture. Our interest in this matter is a good deal, not only in the way of trade, but the effect upon mining interests here in California and in the Mountain States. The *News Advertiser*, of Vancouver, says mines are a thing in which the supply never overtakes the demand, which is true, and there is certainly much promise in the interest at this time for our northern neighbors, especially if they avoid what is called a "boom."

Mr. William L. Ledford, of Butte, Montana, in March, 1893, made a contract with the Anaconda Company, at that place, by which he was to have the privilege until August 1896 of treating all the water flowing from the Anaconda and St. Lawrence Mines, containing copper in solution, which he treated in such a manner as to extract a profitable amount of metal. The company reserved the right of changing the place of issue for the water, and were to have 25 per cent. of the copper saved by Mr. Ledford, also were to acquire his plant free at the end of his lease. Notwithstanding this agreement, Mr. Ledford asserts that the company itself began to treat the water and send it to him sterile, thus depriving him of a profit of $5,000 a month, which he was earning. These facts he set forth in a complaint filed against the company, asking for about $45,000 damages, which, if his allegations are correct, is not too much. A fair inference is that as soon as the Anaconda Company found out the amount of copper in solution, and how to extract it, they cut off the supply by adopting Ledford's methods higher up on the streams.

A copper mine is being opened at Iron Mountain, near the mouth of Spring Creek, on the upper Sacramento River, that may become a property of importance. California at one time gave promise of becoming a copper-producing State, but the failure at the Copperopolis Mines, and the greater returns from the Arizona ventures, caused the work to be abandoned. Copper is just as important as gold. We have never had a quarter or a tenth of what is needed in the arts, if its price was not so high. Roofs alone would consume all the copper in the world if its price permitted, and the manufacture of non-corrosive articles would do the same. Copper is used close up to the commercial limit, and always will be.

The De Lamar Gold Mining Co., of Idaho, are constructing a 50-ton plant for gold extraction on a system known as the Pelatan-Clerici process, a combined cyanide and electric treatment under agitation. Like all other processes it is claimed to be "perfect." An experimental plant has been operating at Denver, Col., for a year past, and a large one has been erected at Milan, in Italy, for treating African ores. The gold is first dissolved by cyanide, and then deposited as amalgam on plates by electric action. The quantity of cyanide, because of the direct application and confined volume, is much less than is required in the common leaching processes. A description of the method will be found in the *Western Mining World*, of October 12th.

The MacArthur-Forrest British patent on the cyanide gold-extracting process has been amended by the Controller-General of patents by a disclaimer and addition to the claims. The inventors in the amendment say they do not claim generally the use of cyanide solutions of any strength, and then in the claims include a "dilute" solution. This, it is said, establishes the British patent, which we doubt, unless a specific, or nearly specific, solution is set forth. However, the acceptance of this is that it confirms the patent, and no doubt it should, but there is no provision for such a late amendment of a specification in this and other countries. There was a good deal of carelessness orginally in drawing up a specification that claimed broadly the use of cyanide when there was so much evidence of its being known as a means of dissolving gold.

The Yukon River country at this time presents some of the features of the early mining period in this State. Wages in the upper placer districts are $10 a day. Timber is only $10 a thousand feet, but freight is 45 cents a pound for sixty miles. It is estimated that in the placer grounds above Circle City, on the Yukon River, there were 1,000 men at work the past summer. The trip there is a great undertaking. Besides an overland journey from Juneau, and through several lakes, there are 850 miles of it on the Yukon, and many rapids to pass that are very dangerous. It is reported that

sixteen men were drowned this year in these rapids. Another difficulty is the insect pests that are found in all high northern latitudes in summer. Flies, gnats and mosquitoes swarm everywhere. The ' yield " in gold this year is meager, considering the cost and discomforts of its procuration.

This is the mining epoch in the world's history. When business on the top of the ground becomes choked and stagnant, people begin to delve beneath. Mining schemes have now to a great extent passed into the hands of powerful money firms, like the Rothschilds; and the prices of certain metals will, no doubt, like petroleum be regulated by international agreements. This is tolerably certain in respect to copper, and may be of lead or silver even, but not of gold, except as to certain fields, like that of the Transvaal, in Africa. Gold is too much diffused for the mines to be "cornered." New fields cannot be controlled except by purchase of all the land, and that is seldom possible.

Condensed Notes.

Down-draught or smoke-burning furnaces are to be tried in some vessels of the Navy, and if successful this means some millions more to change war vessels to this plan, so the smoke will not betray the whereabouts of the ships.

John D. Rockefeller, the international coal-oil man, has given $3,000,000 more to the University of Chicago, and has promised an additional $2,000,000. He has given now a total of nearly 7½ millions to this institution. It is a great Socialistic idea, this drawing that amount from industry and trade, and putting it into an organized educational institution.

The "break" in mining shares and connected African schemes of in all 38 companies, the *Engineering and Mining Journal* sets down at $154,000,000, if present valuation is compared with a year ago. A large share of this shrinkage, amounting to 23 per cent., is a direct loss to investors, and pocketed by speculators.

Telegraph messages are now sent in Italy for five cents each, and as the lines are owned by the government, which is not likely to operate them at a loss, this may be set down as the cost of service. It is time that all private lines were suppressed in every country.

The city of Allegheny, Pa., has outdone even this State by making a riveted pipe five feet in diameter, ten miles long, to supply service water for the city. The pipe is of open hearth steel of

55,000 to 60,000 tensile strength. The plates, half an inch in thickness, weigh 8,500 tons. The pipe was coated with asphaltum sent from this Coast.

The Chicago drainage canal falls 75 feet between Chicago and Joliet, and it is singular that the subject of water power has not sooner been considered. The smallest amount of water, 300,000 cubic feet per minute, would yield 30,000 horse power under this head.

The Japanese in 1894 had 409 steamers and 196 sailing vessels, the former making up 169,309 tons, and the latter 30,177 tons, or together, 193,486 tons. There are large additions now, and Japan is sure to become a formidable power on the seas.

Mr. G. B. McCormack, of Birmingham, Alabama, has discovered that by heating, the iron containing red in fossiliferous ore became magnetic, and could be separated by this means from the gangue with a gain of product as 47 to 60. A long paper on the subject was presented at the Atlanta meeting of the mining engineers. It may have a bearing upon the iron ores of this Coast. The process is now carried out in a large plant.

The *Western Mining World*, Butte, Montana, says that the cost of refining copper matte has by the improvement of processes, especially by the application of electrolysis, been reduced to one half a cent a pound, or ten dollars a ton, and that much of this work formerly done abroad will now be done at home in this country.

The Northwest Mining Association has suddenly grown into a formidable body, and held their first annual meeting in Spokane, Wash., in October. The proceedings will be published and distributed soon. Copies can be procured from the Secretary, Mr. L. K. Armstrong, at Spokane.

The Russians, not to be outdone, are to construct a canal in proportion to their empire and population, between the Baltic and Black Seas, about 1,000 miles long, but partly in rivers. The canal as projected is to be 27 feet deep, and wider than any ship canal now existing. The cost is estimated at $100,000,000, which is little enough certainly.

Mr. Cramp, of the ship-building company, has denounced the treaty with Great Britain in respect to buiding ships of war on the North American lakes. This Jingo idea is no doubt in consonance with British preferance in the matter, but happily there are other people who view that treaty as greatly to the advantage of the United States.

"INDUSTRY."

INDEX FOR 1895.

Miscellaneous—

Miscellaneous—

No. 90. JANUARY, 1896. Per Year, - $2.00
Single Copies, .20

INDUSTRY

A MONTHLY MAGAZINE

DEVOTED TO SCIENCE, ENGINEERING AND MECHANIC ARTS

ESPECIALLY ON THE PACIFIC COAST.

JOHN RICHARDS, Editor Founded 1888. W. D. BENT, Jr., Business Manager

CONTENTS

Registered as Second-Class Matter at the Post Office, San Francisco.

Industrial Publishing Company, 40 California Street, San Francisco.

INDEX TO ADVERTISEMENTS.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

ISSUED MONTHLY BY THE

INDUSTRIAL PUBLISHING COMPANY

SAN FRANCISCO.

FOUNDED 1888. JANUARY, 1896. No. 90

ANNOUNCEMENT.

The present publishers of "INDUSTRY" will not issue the Magazine longer. If a new management assumes the business, proper announcement will be made to its patrons and clients. Five thousand pages of matter, nearly all originally written, have been furnished to our readers in good faith, in candor, and continuous effort toward honesty and truth, but the work is, and has been for several years past, more than their powers permitted, or the patronage of the Journal warranted.

During eight years of publication there has been a great change in the conditions under which a technical journal must be conducted on this Coast in order to secure the commercial patronage required to sustain it. The methods are neither congenial to nor consistent with an independent technical publication devoted to matter such as has appeared in "INDUSTRY," nor with the policy first assumed and continually carried out, that of laying before readers useful truths that would promote their interests and business.

The present issue has been delayed by the illness and absence of the editor. It closes his and the publisher's labors, and it remains to thank many warm friends who have encouraged and promoted "INDUSTRY."

SHIPPING CHARGES AT SAN FRANCISCO.

ADDRESS BEFORE THE SHIP-OWNERS' AND MERCHANTS' CONVENTION.

BY GEORGE W. DICKIE.

The following paper, which contains the concrete facts, and explains the very matters for which the ship-owners' meeting was convened here in November last, received no notice in the press of this City, which, we imagine, is too servile to antagonize certain private interests concerned.

Mr. Dickie said:

MR. PRESIDENT: — when your association asked me to address you on the subject that has brought us together at this time, I did not hesitate to accept the invitation, for I have never missed an opportunity or means for twenty-five years past whereby I might bring this subject before the community.

I am glad to see this meeting, and proud of being permitted to take part in it. I trust that it may be the beginning of an agitation that will not only accomplish the purposes for which it is called, but may have an influence outside of our City and State.

If we are ever to gain a respectable position in the ocean-carrying trade of the world we must begin by working up a sentiment among the people generally as to the importance of having a proper representation in the merchant fleets of the world, that shall be in some way commensurate with the magnitude of our exports and imports. Such a sentiment can be produced only by patient and persistent effort throughout the whole country, in schools, workshops and on farms. The public press should be patriotic enough to keep this matter constantly before its readers as a great national question.

I am often told that in building up an industry sentiment should not be a factor, but I believe that the sentiment of a people is the real foundation of all enterprise, and in order that the United States may participate in ocean commerce to the extent that her own imports and exports entitle her, there must first of all be an ambition throughout the country to carry the products of our own industry under our own flag to every country that cares to exchange products with us, and out of that ambition will result wise laws to

protect and foster the merchant marine, encouraging ship-building and ship-owning.

Last year I prepared a paper on "Some Obstacles to Ship-building and Owning in this Country," which was read at the New York meeting of the Society of Naval Architects and Marine Engineers. This paper was extensively quoted from by the Eastern press, and I will quote from the proceedings of this society the remarks of Mr. Charles H. Cramp, of Philadelphia, in the discussion of the paper referred to. He says:

"The salient features of the very able and interesting paper which we have just heard are its reference to a fact well known to all students of the subject, and yet seldom commented upon, namely, the apathy of the great bulk of the American people towards the national merchant marine, and their indifference to the advantages of controlling their own ocean commerce. This is the real reason why sophistries and fallacies find attentive audiences in our country, both in the press and from the rostrum.

"It is also the reason why every effort that is made to promote the rebuilding or rather the resurrection of our merchant marine proves to be such uphill work, and such a thankless task. I have in the last twenty years experienced this to a greater degree and in a more varied manner than perhaps any other member of this Society, if not more than any other man in the United States, because during that period a large share of my activity in public affairs has been devoted to that object, and I certainly have had a wide and varied experience of obstacles, discouragements and frequently defeat. I have often thought just what Mr. Dickie suggests, namely, that no great or comprehensive resurrection of the American merchant marine to anything like the status it enjoyed prior to its destruction in the Civil War could ever be brought about without first altering the tone of general public sentiment on the subject.

"I have discussed this phase of the question to some extent in papers published elsewhere, and have ascribed the existing state of pubic opinion, or rather the existing public apathy, towards our merchant marine to the fact that the generation now active on the stage of affairs is purely and solely a railroad generation, that is to say, our business people, generally speaking, whether in finance or in commerce, have been trained to regard the development of railways as the one great absorbing field of enterprise in this country. This I think is the true reason.

"I am not willing to believe that the Anglo-Saxon race, as represented in this country, has so far changed its nature in a permanent sense as to have lost that love of the sea and that ambition to rule the waves always heretofore hereditary. I believe, and have so written in published papers, that the time is nearly at hand, if it has not already arrived, when American capital must perforce seek an outlet upon the ocean.

"Let any one take a railroad map of the United States and observe the tangled net work of black lines crossing it in every direction, and the conclusion becomes irresistible that, in our generation at least, there is not much room for more railroads, at any rate no room for any more great trunk lines, such as have been built during the last thirty years, some of them almost spanning the entire continent.

"It is to this fact that I look for an ultimate revulsion of public feeling in the direction of the ocean and in favor of our merchant marine. How long before this modification of public sentiment will begin to take practical effect no one can say, but I sincerely believe it cannot be much further deferred, at least let us hope its approach is near."

I have quoted Mr. Cramp's remarks in full because they touch the foundation upon which we hope to build our new merchant marine. The interior development of the vast country lying between the Atlantic and Pacific required that great network of railways referred to by Mr. Cramp, which not only absorbed much of the accumulated capital of the older States, but raised a mountain of debt, largely due to foreign capitalists, that is today sapping the financial life of the country.

The overshadowing power of this mighty aggregation of capital represented by the great railway corporations, the rapidity and ease with which large fortunes have been made in the manipulation of these great interests, have drawn men's minds away from the sober business of ocean transportation. As the people engaged in the industries of this country recover from the overdose of railroads, from which they have been suffering during the past twenty years, the great natural highway of the nations will, no doubt, receive attention, and our Atlantic seaboard will wake up with the old love of the sea strong as ever, and this Coast will find more wealth in the Pacific Ocean than has ever been dug from the Sierras.

You have asked me to present at this meeting the facts relating to State and municipal taxation of shipping. We hear a great deal of talk of what Congress might do to restore the shipping interests of this country, but such talk is entirely inconsistent coming from California or San Francisco, for no State in the Union has such an iron grasp on the throat of its shipping as this. And San Francisco is the only inland city in the world that has the audacity to tax shipping in a harbor near by, known by the same name, but otherwise has no connection with it. Perhaps this statement needs some explanation, and I should like very much to give it if I could. I have sought for it myself for twenty-five years.

The position of this City is unlike that of any other in the world. It is situated one hundred and fifty feet from the harbor, but that political wall makes it an inland town with a great adjacent harbor, in the management of which the City has no part. The Golden Gate is San Francisco's front door, but the State has a watch dog inside this door to prevent the people from enjoying what by nature belongs to them.

The Constitution of this State, conceived in the sin of a labor agitation, and brought forth in the iniquity of corrupt corporations, does not include the idea that the State should at any time become a great commercial community; consequently we find no provision for the State exercising any care over such interests and industries as would tend to make the harbor of San Francisco, which is by nature one of the finest in the world, a great entry port for the commerce of the western side of this country.

This Constitution provides that all property, real or personal, found within this State on a certain date of each year must be taxed at its actual value at the time. While ship property may not be actually within the State, the evidence of its ownership being found in the Custom House, it is taxed accordingly. For instance, a vessel owned and registered in San Francisco has to pay the same City, County and State taxes as a building on Market Street, valued at the same amount.

Apart from the crushing load thus imposed upon the ship-owner there is the manifest injustice of such a method of taxation, imposed regardless of the fact that maritime nations with whose ships ours have to compete impose no such taxes on shipping, and that from the very nature of its use, shipping cannot share in the benefits resulting from the proceeds of State and municipal taxation for public purposes.

A moment's review of the various public purposes for which the proceeds of State and local taxes are expended will show that shipping derives no benefit from them. The City provides out of the taxes levied, police protection for the property taxed. The vessel is beyond such protection and must protect herself so far as State or City is concerned, yet she must pay for the police in the City streets. The City lights up the streets at night, so that the property owner can find his way through his various properties, and is satisfied to pay taxes for such a benefit. The ship must navigate in the darkness, not in a paved street with electric lights on either side, but she is taxed to pay for paving and lighting.

An expensive fire department is maintained by the taxes to save the City property from destruction by fire. The vessel at sea cannot use the City fire department in case of a fire on board, she must have a fire department of her own, and yet is taxed to support that on land. In fact, no part whatever of the taxes, which at present amount to over two per cent. per annum of the assessed value of a vessel owned in San Francisco, are expended for the benefit of the property thus taxed.

But worse than that, should the vessel that is thus taxed come within one hundred and fifty feet of the City governed and adorned by the tax levied upon her value, and she ties up at one of the wharves near to the City, she must in addition pay the same rate per day wharfage as a foreign vessel next to her, and which is subject to no such tax burden.

Now the wharf is to our ships what the streets are to our buildings. What a protest would be raised by the owner of a building on one of the City streets if after he had paid the taxes that build and maintain them, he was not permitted to open his door and come out on the street, or move goods from his building, without first paying ten or twelve dollars a day for "streetage," and yet the case would be precisely similar to that of a City-owned ship lying at one of the wharves.

If the State of California and the City of San Francisco had an earnest regard for the shipping interests of this community, such as exists in the maritime cities of Europe, there would be no taxes on ships built and owned by citizens of the State, and to every such ship San Francisco would be a free port. The general argument I have just presented against the taxation of shipping is not new, although it is difficult to get the general public to understand its import. Such taxation is simply an act of commercial suicide on the part of a sea-board State or City that handicaps its commerce by such burdens.

Great Britain and Germany are our natural rivals on the sea in the foreign trade. New York is our natural rival in the inter-state and home trade, so far as shipping is concerned. In New York, in 1881, by Act of Legislature, all registered vessels, and all earnings of registered vessel property, were exempted from all taxes for State and local purposes for fifteen years, and on May 17th, 1892, this exemption was extended for a period of thirty years. The provisions of the Act now in force are:

"All vessels registered at any port in this State, and owned by any American citizen or association or by any corporation incorporated under the laws of the State of New York, engaged in ocean commerce between any port in the United States and any foreign port, are exempt from all taxation in this State for State and local purposes, and all such corporations whose vessels are employed between foreign ports and ports in the United States are exempt from all taxation in this State for State and local purposes upon their capital stock, franchise and earnings, for the period of thirty years."

In Great Britain and Germany no municipal taxes are imposed on shipping, only the net earnings of such property being subject to the General Government income tax.

In order to see how we compare with others in the matter of taxing ships, I may quote from the Commissioner of Navigation's last report, in which he gives the amount of taxes paid by some of the great foreign steamship companies.

Name of Line.	Tonnage.	Value.	Taxes in 1894.
Cunard Co.	112,124	$9,703,062	$13,793
North German Lloyd	225,097	15,808,864	22,244
Hamburg-American	200,000	9,886,117	15,621
French-American Line	172,433	22,672,500	34,577
Pacific Steam Navigation Co.	111,937	6,676,715	3,322

Here we have five companies owning 821,591 tons of the finest steamships in the world, valued at $64,747,258, and the total taxes levied on this property in 1894 were $89,557.

Now let us compare our methods with these facts. In the same year San Francisco owned in metal steamers 54,047 tons, and of all kinds of water craft 311,000 tons, valued at $5,354,000, and on that we paid for State and City and County taxes the sum of $94,230. Just think of that! With shipping of one twelfth the value of the five great foreign companies I have named we pay nearly twenty per cent. more taxes. Suppose we in San Francisco owned steamship lines to the value of the five companies I have named. From that property the tax collector would gather in this year the sum of $1,458,000, which is more than all the subsidies paid by their respective governments to the companies named on the list.

Why should we go to Congress asking it to take any action towards the revival of ocean commerce, when by our own State laws we are crushing what little is left of our shipping out of existence? In spite of anything that Congress can do we must continue at a great disadvantage compared with the shipping of other countries

that directly compete with us so long as the State taxes our merchant marine out of all proportion to the taxes paid by competitors. I do not maintain that heavy State taxation of vessel property is a sufficient explanation of the present condition of our ocean-carrying trade, but it has been and is a powerful factor in that direction.

What we as a community interested in all questions affecting the commerce of this port ought to do to relieve our shipping from this burden is the question before us today. If a constitutional amendment is required to make legislation possible, then we must keep this matter before the people of this State until a majority sufficient to make such an amendment is possible.

I doubt, however, if the State of California, constitution or no constitution, has the power to tax vessel property engaged in foreign or inter-state commerce. By a decision of the U. S. Supreme Court, vessels engaged in foreign or inter-state commerce owned in Pennsylvania are not subject to tax under the corporation tax laws of that State. To what extent this decision has affected or may affect the laws of other States taxing shipping I am not competent to determine, but it is worthy of consideration, because the conclusion of that decision seems to me to declare the policy which other States should follow. The case is that of the Philadelphia and Southern Steamship Co. *vs.* Pennsylvania, U. S. Reports, 122, Page 326, and I would recommend all interested to read the remarks of Chief Justice Marshall in this case.

The power to tax inter-state or foreign commerce by any State may at any time lead to disastrous results. If this power exists in the State at all it has no limit, as we are now finding to our cost. The discretion of the State may be at any time and is now exercised in such a manner as to drive shipping from our ports, or to load it with an unbearable burden, seriously affecting the business prosperity of other States adjacent to us, and with whom we desire to do business, and if these States by way of retaliation or otherwise, should impose like restrictions, or to secure trade remove all existing restrictions, as has actually been done in some cases, the utmost confusion would prevail in our commercial affairs. I believe that the taxation of ship property engaged in inter-state or foreign trade by the State in which that property is registered is in conflict with the exclusive powers of Congress under the Constitution.

For the reasons stated I claim that all vessel property navigating the ocean should be exempt from State, County and City taxes. I have heard the objection raised that such exemption would be a

special privilege to one class of citizens, not enjoyed by others. I contend that if the privilege is special, so too is the class of property affected special, in that, as I have shown, it cannot be benefited by taxation as real and personal property are benefited.

Ship property has to bear burdens of its own that other property is exempt from, in being required to take care of itself as well as to contribute to the expense of government, usually far beyond the amount of service rendered in return for such payments. Still further, and all know how well it is illustrated in this port, local taxes on shipping are evaded by owners of large amounts of tonnage, and thus falls the more heavily on the owners of small vessels. Is not the most of our shipping owned by the larger corporations registered in New York by virtue of the company having an office there, where such shipping is exempt from taxation, so that these corporations evade our efforts to tax them more than their competitors in the ocean-carrying trade are taxed?

If California, and this great central port, is ever to take the place that Nature has indicated in the ocean-borne commerce of the world, this slow process of self destruction must stop, and broader and more liberal ideas must guide those to whom we entrust the enacting of laws, that may result either in our harbor and City being the great entry port of the western side of this continent, or may nearly blot it out of existence.

MODERN COPPER SMELTING.

We have received from the Scientific Publishing Company, at New York, issued from their press, a seventh edition of Dr. Peters' *Modern Copper Smelting*, which in absence of our usual review columns this month must have mention here. The work in its former editions is too well known to require explanation or comment. It is not only a standard authority on pyritic smelting, but by comparison is alone, in completeness and scope.

The present edition, rewritten and greatly extended, has the specific merit of explaining various new processes in the reduction of copper, now for the first time made public, being heretofore guarded from such use, also the merit of treating the subject generally so as to embrace advanced practice in all countries where copper is produced and treated.

There is also the excellent feature of extended estimates of the cost of constructing reduction plants, and the cost of smelting, from

accomplished examples and observations, the whole carried out in tabular form, also a complete essay on electrolytic refining of copper, accompanied by similar carefully made out estimates.

Dr. Peters, as may be inferred, has drawn his material from wide and numerous resources, of which full acknowledgment is made. The list is amazing, and nothing but the value of previous editions and the well known professional ability of the author, could have commanded such a contribution and coöperation.

The numerous plates contain drawings that are a luxury to examine in these times when slovenly illustration is common. They are on what is called here bond paper, executed to exact scale by the "wax process," as clear as lithography, and ready for use by engineers in constructing smelting works. All the illustrations are good, and the letter press, paper, and what Mr. Carlyle calls "furtherments" of a publisher, are unexceptional.

The work contains 640 pages, is copiously indexed, and is sold for $5.00, which seems a low price for a treatise of this class and kind.

WORKS ADMINISTRATION.

Lectures before the Students of the Leland Stanford Junior University, Palo Alto, California.

BY J. RICHARDS.

[No. 4. November 31st, 1895. Published by permission.]

MATERIAL AS A COMPONENT.

It may seem tedious that in all this time we have got no farther than estimating and prime cost, but these are very important matters, are indeed the very foundation of successful administration of a works, hence must be carefully gone into.

The third component, material, need not detain us long. It is an element that is to a great degree determinable by simple means in so far as value or price, the two qualifying conditions being cost and waste. There is also in the matter of material, wide problems of an engineering nature, but these have been so ably treated here by Prof. Smith, and laid down in his writings on the subject, that in so far as metals it is only necessary to refer to his treatise on "The Materials of Construction," published in 1893.

The economic problems are quality and waste, and the first is so nearly the same as adaptability, that we may assume that this too is included in Professor Smith's lectures. Wastes are determinable

by records. By waste is meant what is cut away by cold shaping, by oxidation, and other losses, also in moulding; is the difference, so to speak, between the stock-room and warehouse weights.

The wastes in wood, iron and steel are between ten and twenty per cent. in machine construction, when there are fitted and finished parts, but as estimating is usually done on gross weights, or should be so done, there are no allowances except for spoiled or broken parts. By no allowance is meant special allowance, because in estimating, the weight of a shaft for example, the contour or rough dimensions are assumed, but if the shaft is ten feet long, and if the bar from which it must be cut is twelve feet long, there is a waste of one sixth, less the scrap value of what is cut off. The piece may be used for some other purpose, but it must be stored, remembered and probably cut again. To weld such pieces will cost the difference between their value in a bar and as scrap, so it is waste at any rate, and should be so regarded.

These remarks, which are only in illustration, are preliminary to suggesting that in estimating for common machinery there should be added about five per cent. for the waste of material, counting from prepared castings, from metal in bars, and other material in corresponding condition.

The methods of arriving at the amount of material consumed in work are various. A common one is to weigh in all kinds of material as it is used; another is to weigh the completed work, add for waste, and then make up separately the brass, screws, lining metal and so on, and deduct these to find the weight of frames, but on the whole it may be doubted if any rules that could be given here will have much value. The matter should be left to the judgment and ingenuity of each person to work out in their own way. One thing, however, may be noticed, that is the method of computing weights, or rather the "habit" of computing weights, because the method is a kind of mental mensuration that enables one to guess very closely the weight of a structure of any kind.

In England this work of taking out weights has become a special calling, done by what are called "quantity clerks," who become so expert by the use of rules, tables, implements and memory that weights are arrived at with great rapidity; so also other things, such as the amount of work involved, computed from the surfaces turned, bored, planed or finished, the number of screws, nuts, tapped holes, rough drilling, and so on.

I was present some years ago when Prof. Hesse, of the Uni-

versity of California, was called in to examine the armature of one of the first alternating dynamos sent to this Coast, which went to pieces, cutting off beams, going through walls, and smashing various things in the plane of its rotation. The parts were hunted up as far as possible, some of them being found in an adjoining enclosure across the street. The manager of the works proposed to weigh them, but Prof. Hesse said: "That is useless, the weights arise out of dimensions, and will be found easier in that way."

A good way to manage for rough weights is to have castings and forgings weighed and marked as they leave the smith shop and foundry, and the weights charged to the work in process. This is essential in a works where the labor is performed under a contract system, because the machine-shop weights must correspond to the foundry weights, which are paid for by the ton, divided into classes.

In the management of a works of any kind the principal thing about materials is to have them at hand ready. It is hard to impress any one, not experienced, with the importance of this, and it would be incredible if there was some way of showing the losses that actually occur from a failure to have material and stores ready when required. In a shop experience of some years on this Coast, this of all things caused the greatest annoyance. Perhaps some account of this will offer a suggestion.

It was at first a daily if not an hourly occurrence for the tool and store keeper to report: "We are out of half-inch washers; there is no emery cloth; the twelve-inch bastard files are out; there is no waste; certain sizes of tool steel are all used up," and so on. Inquiry and scolding did no good. The thing went on with considerable loss each day, and was clearly a fault of management. The store keeper, who was a very conscientious man, came in one day to report that some stores were wanting. "Go and procure them," was the instruction, "and mark off your time card, now and in future, all the time down to minutes that you spend in going after things in working hours, and as soon as your cards are clear of such charges your wages can be raised, because of the saving effected in the shop." The entries for lost time soon disappeared.

THE RELATIONS OF CAPITAL.

It has been shown that under a contract system of skilled work the men do not deal directly with capital, that being the care of owners, but every one in a works, no matter what their position may be, is interested in capital indirectly, because without this there can

be no works, either in organization or implements; besides, the students here may stand in the relation of owners, managers, draughtsmen, clerks, or workmen, and in all these positions it is desirable if not essential, to have some intelligent views of capital, the same as of material, implements and management, that is, of the relations of capital.

This is especially desirable in this country, where it is common to balance the use of capital against other considerations, making that a permanent element instead of an employed one.

In the first place we will inquire what the term capital implies or includes in a manufacturing business, and here we may say as to the nature of capital, most of the explanations handed down by economists are not very complimentary to their understanding of the subject. In this remark, however, must be omitted Dr. Adam Smith.

Smith, as before mentioned, who in his great work, *An Inquiry Into the Wealth of Nations*, published in 1776, says that "capital is the productive investment in a business; that part which is actively employed to earn profit." These are not the words, but the substance of his definition, and it is quite correct, but as before intimated, there have been long dissertations on the subject, in which men differed, down to the time of Mr. Henry George, who set this matter at rest forever in a single sentence. "Capital," said he, "is what is written in the capital account."

The whole mass of literature on this subject beside, does not afford the light that these few words do. In the abstract, such a simple statement as this would seem trivial, but in the light of what preceded by other economists, the words are a revelation.

People engaged in business have an interest in this problem, and it is necessary to know in the accounts what is capital and what is not. It is common to segregate this element from others and write it in a "Capital Account." This is what Henry George meant, not that the capital account included what was used as capital, which is self evident, but that the things included or listed in this account are such as have been disputed over. As remarked, every business has, or ought to have, a capital account covering investment in buildings, implements, and all the agencies of production owned, but not merchandise, material or wages.

This later statement may appear puzzling to those who have not given previous attention to the subject, because, as all know, it requires a fund to purchase and hold material, also to advance wages for a time, or during the progress of constructing some work, but

neither of these things are capital. In some cases there is no material to provide. The mineral reduction mills at Virginia City, Nevada, and custom mills of this kind elsewhere, are an example. The material is furnished by others, and the mill owners provide only implements, labor and expense. The same is true of custom grinding wheat, and many other operations that will occur to you, where the material is sent in to be treated and returned in kind or in results.

If the owner of a works purchases material he does not pass the purchase to the capital account, but to the merchandise account, which is debited to the amount of the purchase, and credited again when the material enters into work made and sold, so the use of the capital or the material is more in the form of a loan or credit, the real manufacture relating to changes made in the material, such as converting cotton or wool into cloth; or iron, steel and brass into machinery. What the manufacturer employs is the use of the money so invested for the time between the purchase of material and its sale again as a product of the works.

This use of capital, if there has been no change in the price of material, is chargeable with interest for the time, but the investment, or use of capital as we are now terming it, may be a source of profit or of loss by reason of fluctuations in the price of material held. If, for example, a machine-making firm or company purchases iron at fifteen dollars per ton, and during the time of its conversion the price of iron rises to twenty dollars a ton, the gain of five dollars on each ton is not the result of manufacturing, but a profit of trading in merchandise, and conversely, if there is loss by reason of a fall in prices, the loss should go either to loss, or to expense as an element of risk.

These things will be made more plain by noticing the methods of use, or in other words, the organization of a business in respect to capital. In this country the shares or interests in a business are commonly based on capital, that is, the ownership of a business and a division of profits is as the capital provided by the partners in a firm. This is not always the case, but is common, and the usual idea of business ventures in skilled industries in this country. The reasons for this are no doubt the risks involved in such business owing to fluctuations in prices and in other ways, and on that ground may be fair and equitable.

It is easy to perceive that logically considered, and aside from special risk, that is, risk not covered by the rate of interest, capital

is an element that has nothing directly to do with personal interests in a skilled manufacture, and this is very nearly the case in founding an engineering business in England.

The partners or owners are expected to contribute skill, service and connection, and on this the business is founded. If the partners own capital, they can invest it or not. It is hired from the partners, some one else, or from a bank; standing in the same relation as implements, buildings, and so on.

It is easy to perceive the effect of this. Chemists, shoemakers and farmers do not engage in engineering manufactures, as they may and sometimes do in this country. In great firms like Maudsley's, Penn's, Tangyes, composed of many members, there will be no one not a mechanic or engineer.

This is proper and desirable in every way, and will become the rule in this country before long. Circumstances are fast tending in that direction for that class of industry called engineering manufactures.

If the technical education sought in this and other institutions of the kind cannot be balanced against capital or commercial skill, its value is doubtful. It is common for men to say "I can hire all the skill I need," but this is not true of the present, and certainly will not be true of the future.

A man may inherit or purchase an interest in a business already founded, of which he has no technical knowledge, and such business may go on successfully with accession of this kind, but the chances of failure are increased accordingly.

Before leaving what may be called the economic part of the subject, and supplementary to what has been explained in respect to the four components of production, I wish to point out that the components, material, labor, expense and profit constitute price, or the amount that is paid for commodities. The price for staple commodities, such as manufactures of iron, wood, leather, and so on, is fixed in the neutral markets of the world, and not controllable in any one country, except so far as taxed to the people of that country, or as a bounty is paid for production. Thus it will be seen that the whole assumes a mathematical form, that of an equation, in which the price equals the four components named.

Now it is obvious that these components can be varied relatively without affecting the equation. The price of labor can be increased

if a like amount is taken from material, expense or profit, or the price of material can be increased if the increment is taken from labor expense or profit, but change the matter as we may, the aggregate must remain the same to balance price.

It is also obvious that no nation or people have the power to control or much alter the price of staple commodities, and whatever enters the world's markets must be sold at the world's price. The country having the cheapest material, labor and expense will successfully export their products, but when I say cheap labor I do not mean low wages.

Fifteen years ago wages in the Geneva watch-making industry were in francs about the same as wages were in dollars at Waltham, but the American labor was the cheapest, and watches made at Waltham were sold all over Europe. In England wages are, and have been for half a century past, much higher than on the Continent of Europe, but the cost of labor was less in England, so that in a division of these elements or components of skilled production, labor must be considered at its cost, and this is very different from the rate of wages.

HANDLING OPERATIONS.

Thus far in these lectures on Works Administration the subjects dealt with have been mainly the conditions that attend on administration, and no doubt less interesting than what we may call practical matters, or the manipulative process of performance. We will now turn to this branch of the subject, and commence with some of the conditions that affect buildings.

General rules that apply to the arrangement of factories and workshops are not many, as may be inferred from the extreme diversity that exists, but such rules as do apply have no attention to speak of, and it would be hard to name any other thing that is so much lacking in uniformity and design as buildings for industrial purposes.

There are certain industries, uniform in nature and old in practice, such as cotton spinning and weaving, that one finds housed and arranged in a tolerably uniform manner, especially in Europe, where cotton mills are sometimes torn down and rebuilt to gain a few feet in width demanded by modern machinery for spinning and weaving, but were it not for this obvious condition of fitting the buildings around the machinery it is doubtful if there would be two mills alike even there.

Grinding grain is an uniform operation the world over, if we except roller and buhr grinding, yet the mills are built in all conceivable forms, externally and internally. The causes for this are the absence of rules and information respecting designs, the method of receiving and discharging material, the configuration of ground and its value, and the extension of industries from a small beginning by patching on, as it is called.

With this many reasons, and a good many more not mentioned, diversity is not to be wondered at, but there is at this day some approach to uniform plans for machine fitting shops, that had its origin in England, so far as I know, that of an open central gantry, spanned by overhead traversing cranes, and stages at the sides occupied by machines and fitting conveniences.

Omitting architecture, the strength of buildings and their foundations, the beginning part in planning a works is the handling of material and the completed product, also material during the successive stages of conversion. This is the foundation, so to speak, that must always in a considerable degree affect an expense account and also determine the amount of room required.

Handling is of two kinds, horizontal and vertical, and it will be new no doubt to claim that vertical handling is not only more convenient but much less expensive than horizontal handling. As an example, the ore from deep mines is raised at the rate of two to three thousand feet per minute, and in some exceptional cases at a rate of four thousand feet a minute, or a speed exceeding that of common railway trains. Now we all know that material cannot be moved at this rate horizontally, or at less than three times as much expense if loading and discharging are included, and the same thing applies, but in less degree, in a machine works or factory of any kind.

This fact has become so apparent, in England especially, where room is restricted, that there is but little horizontal moving of machines or material in a works, and the effect of this is much wider than will at first be supposed. For example, whenever material or work has to be moved horizontally on floors, there must be a clear path for such movement, and it is found that in fitting and erecting shops the amount of work produced on a given area can be twice as much as can be done on the same area if the work has to be moved on floors horizontally.

I have in mind now a works in Salford, England, where the erecting floor is nearly impassible, and where there are left only narrow passages for the workmen to get out and in. If a machine is to

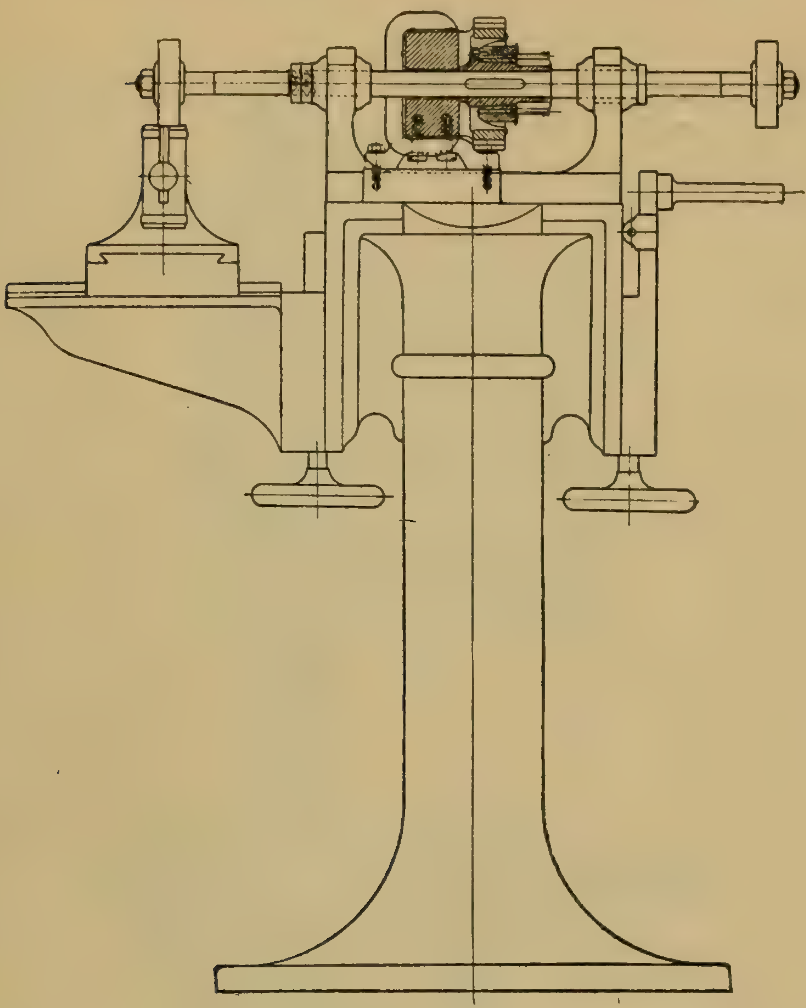
be moved it is lifted vertically over the top of whatever lies in the way, moved to its new position and lowered. If a piece is wanted of a weight exceeding what one man can conveniently carry, the crane attendant is signalled, and he does the handling, not only bringing the piece to where it is wanted, but placing while in suspension.

This matter once made a great impression on my mind at the works referred to. I was being shown over the place by one of the owners, with whom I was well acquainted, and when midway on the erecting floor, where we had made our way with much difficulty, he stopped at the end of a planing machine that stood under the gantry and said: "Now I will show you how we handle things here." He signalled the crane man, toward the cleaning room between the shop and foundry, who came instantly overhead for orders. "Bring top carriage, No. 3, Order 400," said he, and in less than two minutes the piece was overhead descending in front of us, and was laid gently on the planing machine bed, a saddle that weighed several hundred pounds. "Hold on," said he, "we will not want it at present, you may return it," and away it went again, sailing through the air, no one noticing or regarding the matter except ourselves and the man on the crane.

The overhead cranes were moving continuously from place to place, picking up and placing pieces from a hundred pounds to thousands. This was at the Gresley Iron Works, at present extended and rearranged, but no doubt just as condensed now as then.

In these works, it may be remarked, were kept the most accurate system of accounts and records that I have ever known in any machine works. The work made is machine tools of a high class, and by a mental estimate made at the time, twenty years ago, and by comparison with the machine-tool works in Philadelphia, the floor space occupied for a given number of men and product was not half as much as in Philadelphia.

The main factor in this was vertical handling, and it is easy to imagine the effect by comparing with a works provided with elevators, but not cranes. The moving of anything on the floors is a difficult matter until an elevator is reached, then all difficulty is ended, except loading on the platform, and this must be included in the horizontal part, because with overhead traversing tackle no loading has to be done.



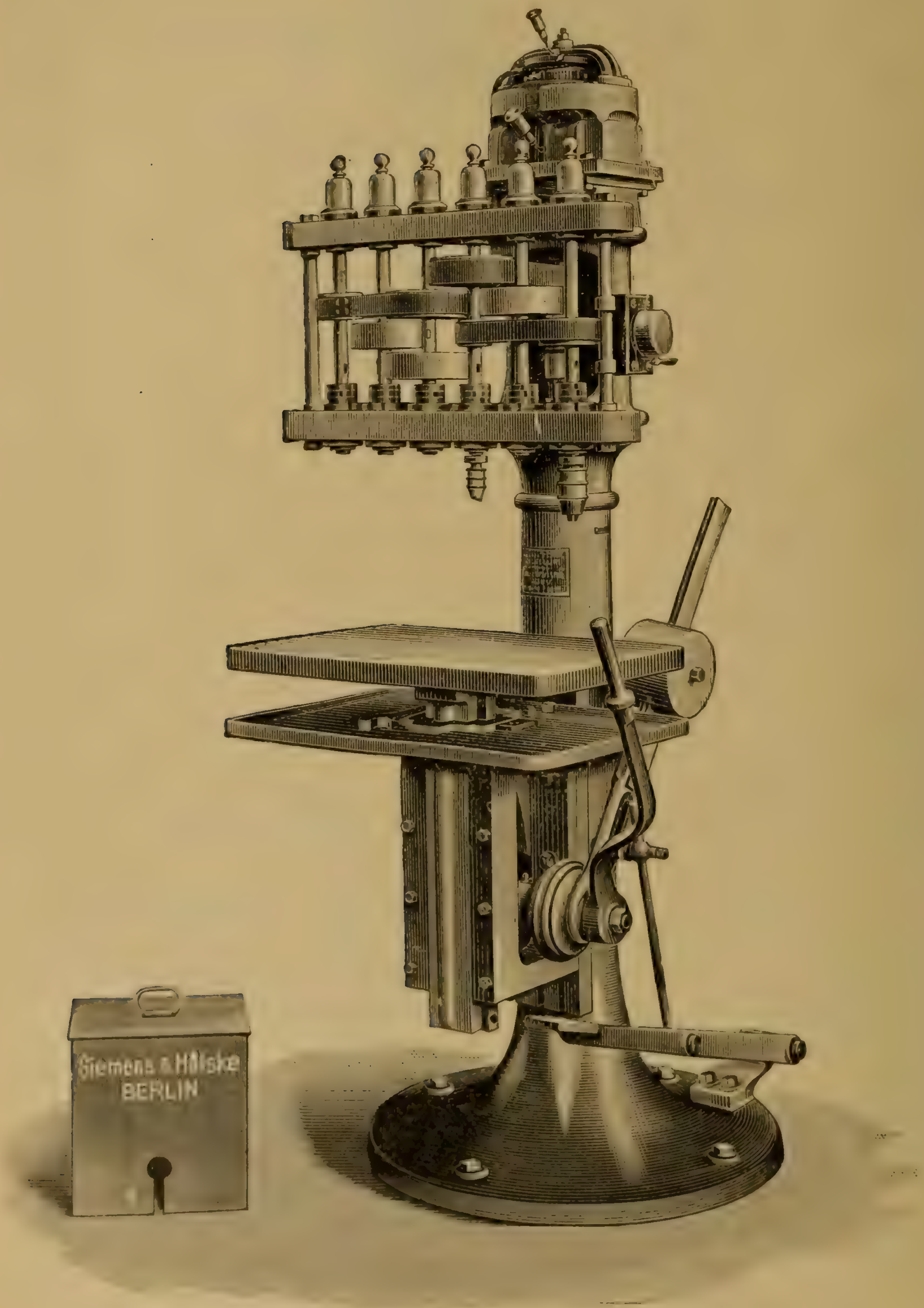
INTEGRALLY MOUNTED ELECTRIC MOTORS.

SIEMENS & HALSKE ELECTRIC CO.

We some time time ago commented upon a seeming want of confidence in the segregated electric driving of machines, indicated by setting the motors on a shelf, or on the floor alongside of machines to be driven, instead of constructing the motors, or at least the field framing, as an integral portion. Since then we have received from the Siemens & Halske Co., drawings of a large number of machines integrally equipped for driving in this manner, two of which we reproduce here.

The one above is typical of machines having high-speed horizontal spindles, where the motor is applied directly on the spindle, and on the next page is shown a drilling machine having the motor attached directly to the first vertical mover.

There is perhaps not much calling for comment in either case, except to point out how completely such motors lend themselves to the duty, and that the method has extended to a class of machines



DRILLING MACHINE WITH MOTOR DIRECTLY ATTACHED.

SIEMENS & HALSKE ELECTRIC COMPANY.

proverbially behind in such matters, that is, metal-working machine tools.

The economic points in this method of transmission lie mainly in avoiding the waste of power consumed in driving idle apparatus, and in the arrangement it permits in works where overhead driving apparatus is dispensed with. In fact the most serious objection of all to line and countershafts is their interference with what would otherwise be a common arrangement of machine shops with a gantry and traversing cranes.

A network of belts overhead if it were not an inheritance would not be tolerated. We know of one works where to avoid this feature they put the line shafting and countershafts beneath the floor, which was, however, a good deal worse than to endure them overhead.

In recent modifications of electric motors we observe the absence of a good deal of the details that were once thought to be essential, and if a really good motor can be controlled by a switch alone there seems no reason why almost any machine with rotary motion should not be so driven when current is available.

The Siemens & Halske Co. have recently published a very complete essay on the subject of electric rock-drilling machines, which from a cursory examination seems to be proceeding in "sound lines." It is not a solenoid arrangement, but a mechanical drilling apparatus impelled by a common rotary motor, transmitting by means of a flexible connection. Copies can be procured from the agent here, Mr. A. E. Brooke-Ridley, 10 Front Street.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

On this Coast there has been many commendable gifts by rich people, to endow or otherwise promote works in art, science and education, and it will be no disparagement of such gifts to say that a laudable desire on the part of the donors for the good opinion of their fellow men, has been at the bottom of most of these gifts and donations.

It is singular, however, and perhaps an oversight, that no one has thought of bestowing in their name funds to found awards to deserving people or for meritorious work, as is done at Philadelphia,

where the Franklin Institute is a custodian and judge for the distribution of such awards.

There are a number of these awards there, such as the Elliott Cresson medal; the John Scott legacy; the Longstreth medal, and others that bear the name of their founders, and will continue to do so no doubt, for centuries to come.

So small a sum as one thousand dollars will return fifty dollars a year to be awarded to some useful invention or work to be adjudged by a committee of arts and sciences, worthy of such distinction. The work of investigation and procedure would fall on the custodian, which on this Coast for scientific engineering or mechanical works, would naturally be the Technical Society of the Pacific Coast. They have among their membership the required elements to form and maintain a committee on awards for any of the various branches of industrial discovery and improvement. This work would be congenial, and a proper part of the functions of that association.

There are in this City a score of men who would never miss the small sum required to found a reward for meritorious work, and who would by reason of their long connection with public and industrial affairs, derive more pleasure and honor from such an award in their names than could be gained from ten times the amount spent in some other manner.

Take the case of Edward Longstreth for example. He was at first foreman, and then an owner in the Baldwin Locomotive Works, and on retiring he wanted to be remembered by his colleagues and fellow mechanics. To do this he devoted one thousand dollars as a fund, the interest of which is to be forever devoted to an award of a medal annually to some one deserving such distinction, as the Franklin Institute may determine.

The John Scott legacy, consisting of the proceeds of $4,000, was provided by a chemist of Edinburgh, Scotland, whose name thereby is known to thousands who have reason to admire his act and its objects, and would otherwise never have heard of the donor.

The Elliott Cresson medal is provided by an investment of $1,000. Mr. Cresson was a scientific man of eminence in Philadelphia, who will always be remembered by the awards made in his name. If the Technical Society will establish a committee on arts and sciences, the awards would no doubt be provided by those who want their names honorably perpetuated.

Continued from page 720.

MACHINES AND PROCESSES.

THEIR NATURE AND ECONOMY.

BY J. RICHARDS.

FOURNEYRON TURBINES.

Fourneyron wheels can be described as those with radial flow, from the center outward, and bear as a class the name of the distinguished inventor, although in fairness his name should cover turbine development of nearly all types. His discovery described in simple terms consisted in reversing the discharge flow in respect to the wheel, and eliminating it in respect to stationary objects, giving rise to that common axiom, "the water should leave the wheel without velocity."

This latter is the constant characteristic of efficiency, applicable not only to turbines, but to all water wheels, but is possible only by the reversed curves of turbines. In overshot, undershot and current wheels the water leaves the wheel with the same velocity at which the wheel is moving, because the course of the water is not reversed, consequently the efficiency in such wheels falls to fifty per cent. or less. In flat vane wheels the velocity of the water may be wholly checked in respect to the course of the wheel's rotation, but the residual or second flow is not reversed, as in the case of a turbine, is lateral or radial, and normal to the course of impingement, giving a still lower efficiency, not exceeding 40 per cent.

From this will appear the importance of Fourneyron's invention of the "reversed flow," which marked a revolution in water-wheel theory and practice, and may even be said to constitute the foundation of hydro-dynamics. This important discovery, ascribed to M. Fourneyron, by Prof. Henry Robinson,* is an imperishable monument to his genius, and should have given his name not only to the radial type but to all kinds of wheels operating with a reversed flow of the water.

If these claims in his favor are correct it is singular that the modification selected by him, or the one that bears his name, cannot be considered as the best type among turbines, in respect to average conditions of adaptation or use.

Fourneyron or radial-discharge turbines have the following characteristics:

* Hydraulic Power and Hydraulic Machinery, London, 1893, pages 172–173.

The running element or the wheel proper is the outer and larger member, the guide vanes or diffusing element being in the center, and the wheel disposed as an annulus around these, consequently it must be of large diameter and the principal member.

A common opinion is that the Fourneyron type is the only one among turbines that has a natural discharge, because of the water flowing in the direction of centrifugal effect, which seems a reasonable assumption until the path and rate of the radial flow is considered, then it will appear that the water is not carried by the wheel, and does not revolve, consequently there is no centrifugal action to be considered.

The wheels must be set at the bottom of the head, consequently are submerged when running, also require a wide space all around to permit free off-flow of the discharged water, so much room indeed as to prevent the use of Fourneyron wheels in narrow pits or in rows, when several are required.

The radial flow, while it may, as before remarked, seem natural, is the reverse of this. An elementary rule or law of hydraulics is the maintenance of an uniform section and velocity in water ducts, scarcely possible in constructing a Fourneyron wheel.

JONVAL TURBINES.

The invention of M. Jonval marked an important addition to turbine practice. His wheels are called those of axial flow, because the water passes through the wheel parallel to its axis, with but slight divergence from a direct line or course. They are in many respects the highest type of turbines, and lend themselves to various adaptations in a greater degree than any other modification. They are, however, expensive to construct, and consequently have not met with such wide use as other cheaper modifications to be hereafter noticed.

The characteristics of Jonval turbines are as follows:

The wheel casing is to a great extent an integral portion of the wheel or the guide vanes, and of a form that cannot be produced from plates, consequently must be made of cast iron and carefully fitted.

The water after passing the wheel is not diffused or spread, consequently can be collected in a draught pipe, and the wheel casing and gland around the shaft must be air tight.

The wheels can be set above the waste way and drained at any time for inspection or repairs, but if submerged are not impeded by back water, except by lack of pressure, or loss of head.

The Jonval type of pressure turbines with slight modifications can be altered to impulse or unfilled wheels, and thus adapted to high heads or pressures, as in the case of the Guyelin-Jonval wheels erected at Niagara Falls, 1894.

The lateral dimensions are smaller than in the case of any other class of turbines, consequently the wheels are well adapted for erection in pits or in rows, where a number are to be erected, as at the Fairmount Water Works, Philadelphia, one of the finest examples of turbine practice in this country.

INWARD FLOW TURBINES.

These, the most numerous class of water wheels at present employed in this country, were in so far as their practical evolution developed by American makers, and must be admitted as an important advance in water-wheel practice. The term "inward flow" does not accurately describe the wheels, because the flow is inward and downward, the latter not being escape alone, but a function of the wheel's action and power. They are also called center-vent turbines.

The French call them "centripetal" wheels, because the water at first flows opposite to centrifugal force, or in the direction of centripetal restraint. These wheels have not, however, met with much favor in France, or in Europe generally, because mathematical analysis of their operation fails to account for an efficiency which in fact far exceeds what computation will accord. They have a number of characteristics that can be stated as follows:

The issues are large, the streams or jets few in number, but of large volume, so that drift wood, ice or other obstructive matter in the water can pass without clogging, a feature of much value in streams that flow in alluvial beds, and such as are common in this country throughout the whole region between the Allegheny and Rocky Mountains.

The wheels are cheap to construct, because the running element, or the wheel itself, is of small diameter. It is directly around the shaft, and as a structure or casting partakes of the nature of a common gear wheel or pulley, that is, has a nave or hub with radial members and an enclosing hoop or ring. The stationary member or guide-vane element does not require accurate fitting, is of greater diameter, and consequently affords convenient attachment to foundations.

The guide vanes being external and accessible, they afford a means of regulation by pivoting or hinging the vanes, and thus

control the volume of water, but at a considerable loss of efficiency, because in that case the wheels are not filled or under full pressure as with a full flow.

The discharge of water being downward, and nearly solid, these wheels offer the best possible facility for employing draught pipes, consequently can be set at a convenient height above the tail race or discharge plane. This feature is one of much importance, and as in the Jonval type, avoids completely impedance from back water, also permits drainage of the wheel case and penstock for inspection and repairing.

The speed of revolution is greater than in other forms of pressure turbines, and this with the other features, especially the large volume of water that can be applied, equaling in some cases 100 cubic feet per second for a wheel only 36 inches diameter, constitute the American or centripetal type of turbine wheels the best form for low heads, and it is in this service their use has extended to such an extraordinary extent in this country. They are essentially low head wheels, with constructive, economic and other limitations that point to heads not exceeding forty feet. From this upward the volume of water is too small in most cases to demand the large issues or permit coarse construction. The high speed of rotation also becomes objectionable in respect to maintaining bearings and gearing, and the efficiency falls off in a proportion that these conditions indicate.

Taking into account the economy of construction, erection, gearing, freedom from obstruction and wear, speed of rotation and the achieved efficiency of the American centripetal or inward discharge turbines, there seems to be but little room for their improvement over existing practice.

The wheels have been tentatively developed, almost without the aid of science, as the diversity of practice as well as the history of the art will show. The modifications form an interesting study, culminating no doubt in what is called the Risdon wheels, and others copied after these, in which the initial vane faces are convex, and come near presenting a plane normal to the entering water at all positions.

As to the efficiency of turbine wheels of different kinds, it is a subject of continual discussion and diversity of opinions, but if we consider all the various kinds in use that are well constructed, there is but little difference in their useful effect, and if critically examined it will be found that the generic feature is throughout a "reversal of flow," producing impediment to escape in pressure turbines, and reactive force in all kinds of open or impulsion wheels.

IMPULSION WHEELS WITHOUT REACTION.

Wheels of this class included all, except gravity wheels, previous to the invention of Fourneyron, such as undershot wheels, saw-mill wheels, and others with flat or radial vanes, including tangential wheels as first made in California, in other words included all open or unfilled wheels wherein the flow of the water is not reversed.

The sole effect is by impingement of the water, because the second or diverted flow is either radial or lateral in respect to the plane of rotation, consequently exercising no turning effect upon the wheels. It is believed that, in the case of flat vanes, a cone of water practically stationary, is set up in the center of the jet, diverting the water laterally so as to cause a considerable loss of its impinging as well as all of the reactive force, and in any case the residual velocity of the water is equal to that of the wheel, and the efficiency attained is not more than 40 per cent. No wheels of this type are now made, unless in cases where the loss of water need not be considered.

IMPULSION WHEELS WITH REACTION.

This important class of water wheels, now the most numerous made in Europe, and fast coming into use for high heads in this country, is the plain impulse wheels, provided with curved vanes or buckets to reverse the flow of the water, or is the application of Fourneyron's invention to the open or impulse type of water wheels, the same as he applied it to reaction and other filled or pressure wheels.

This principle of reversed flow is not however identical with that in the pressure class of turbines, because in that case it is an impedance to flow that causes the water to escape without velocity or energy, and in the open or impulse class of wheels, is a reversal of the moving energy of the water, or reaction it may be called.

The Girard class of wheels is the plainest example of this mode of operating, because the motion of the water is practically in the plane of rotation and reversed in this plane, while in the tangential type of wheels the angle of incidence is such that there is not room for reversal in the plane of the wheel, consequently the water is divided by a wedge and diverted laterally each way from the center line or course, of impingement and backward as in the Pelton wheels, now extensively employed on the Pacific Coast, also in the Knight wheel and others that receive the water tangentially.

This type of water wheels, that is, open wheels with reversal or reaction of the water, have certain characteristics that may be stated as follows:

The spouting force of water being theoretically equal to its gravity, less the friction of discharge orifices, the efficiency of impulse wheels when combining reversal or reaction with impingement are of the highest efficiency.

As the diameter of the wheels, or their rotary speed, need not bear any particular relation to the volume of water or its pressure, the wheels can be made of any diameter or to run at any rate of revolution to suit the purpose to which they are applied. This permits an adaptation not attainable with pressure turbines.

There are no running joints to maintain against water pressure, consequently no running contact between surfaces and no wear of the wheels, except by sand or grit carried in suspension, which wear is in practice inconsiderable. There being no running joints or contact, no submerged bearings or casing to sustain pressure, the cost of construction is much less than for water wheels of other kinds, and the expense of maintenance still less in proportion.

There is no limitation of head or pressure up to thousands of feet, the efficiency following in the constant proportion. The limit in the other direction is the volume of water, or the number and size of the jets, and a reduction of diameter to produce the required speed under low heads, which is not possible with tangential wheels for heads less than about 50 feet.

To avoid the influence of gravity on the water in action, wheels of the tangential class require to be placed on horizontal axes, unless arranged like the de Laval steam turbines for lateral discharge at one side.

Open wheels of the Girard class discharging from the interior outward, and Jonval wheels arranged for impulsive action, can be mounted on vertical shafts, the latter especially, but horizontal shafts are preferable for the Girard type.

All open wheels with a single jet, or receiving water at one side, produce a lateral thrust on their axes as the turning force of the water and the radius of the element of transmission, or as the force of the water multiplied by the diameter of the wheel and divided by the diameter of the pulley or wheel of transmission. Such wheels must be set above the plane of the waste water, being inoperative if submerged.

Open or impulse wheels have been strangely neglected in this country, all attention for fifty years past having been given to the pressure class of turbines, but circumstances now point to a much wider use and to better understanding of the open type most suitable for high heads and pressures.

REACTION WATER WHEELS.

Barker's mill, familiarly known to every one, forms the best example of reaction water wheels, although in construction it varies widely from practice. Reaction wheels, when on vertical shafts, are commonly formed like an inverted tub, with tangential issues around the periphery, the water being led in from below.

There is a problem as to the principle of action in a Barker wheel, which although it may be very clear in a scientific sense, remains a puzzle to the minds of many who are well versed in water-wheel practice, some contending that the power is directly from unbalanced pressure, others that it is from the dynamic reaction of ponderable matter forcibly discharged. It is one of the problems so difficult to determine by ordinary standards, that it often serves as a matter of debate between those who hold different views.

Presuming the vertical shaft and the horizontal arms of a Barker wheel to be filled with water under a head of sixteen feet, there would be a pressure of about seven pounds upon each superficial inch of surface within the cross arm, exerting an equal force in every direction. By opening an orifice at the sides of these arms equal to one inch of area the pressure would at that point be relieved by the escape of the water, and the internal pressure be unbalanced to that extent. In other words, opposite this orifice, and on the other side of the arm, there would be an unbalanced pressure of seven pounds, that would act as a propelling force to drive the wheel.

The other theory is that direct action and reaction being equal, ponderable matter discharged tangentially from the periphery of a wheel must create a reactive force equal to the direct force with which the weight is thrown off. To state it otherwise, the spouting water that issues must react in the opposite course in proportion to its weight.

The last seems a plausible theory, and perhaps a correct one, but there are two facts in connection with the operation of reaction water wheels which seem to controvert the latter and favor the first

theory, namely that reaction wheels in actual practice do not attain an efficiency of more than forty per cent., and that their speed may exceed the initial velocity of the water.

POSITIVE PRESSURE WHEELS.

Pressure wheels, like gravity wheels, should, from inference, be expected to give a high efficiency. The water resting with the whole of its weight against the vanes or abutments, and without chance of escape except by turning the wheel, seems to meet the conditions of realizing the whole effect due to the gravity of the water, and such wheels would no doubt be economical if they had not to contend with certain mechanical difficulties that render them impracticable.

A pressure wheel, like a steam engine, must include running contact between water-tight surfaces, and like a rotary steam engine, this contact is between surfaces which move at different rates of speed in the same joint, so that the wear is unequal, and increases as the radius. When it is considered that the most careful workmanship has never produced rotary engines that would surmount these difficulties in using steam, it can hardly be expected they can be overcome in using water, which is not only liable to be filled with grit and sediment, but lacks the peculiar lubricating properties of steam.

This impediment of unequal wear is inherent in all machines where radial-running faces have to be maintained, not only those to prevent the escape of fluids, but in resisting wear. There are numerous examples and proofs of this in rotary steam engines and pumps, also flat thrust-bearings and radial bearings generally.

The sum of what may be called surface movement in wheels of this class is, as was pointed out in the case of piston steam engines, enormous, and under conditions such as exist in water motors cannot be maintained except in slow-moving machines operating with pistons, the only type of pressure water motors that have any place in common practice.

CONCERNING FLY WHEELS.

Every one must admit that a fly wheel is an abnormal element in machinery. It is commonly a sequence of reciprocating motion by means of a crank, sandwiched in between, so to speak, a kind of disagreeable and expensive necessity to correct the infirmities of the modern steam engine "as she is made."

We suggested recently to Mr. Dickie, of the Union Iron Works, that in view of the numerous and increasing number of accidents, such wheels should not be made of cast iron. He remarked that "a better way would be to not make any fly wheels at all. We seldom make one nowadays, and pretty soon will stop altogether wasting material in that way."

It required two or three days to arrive at the force and significance of this remark, and its summing up was something as follows:

Among the last dozen of large steam engines made in this City, there is hardly enough fly wheel to supply one large slow speed single crank engine. Most of them, including all the marine engines, have no fly wheels at all, and do not need any. Three engines, of 12,000 horse power each, for the Market Street Railway Company, have no fly wheels. The principal engines in the Edison Electric Power & Light Company, have no fly wheels, and it is easy to see how with the present trend towards multiple cylinders, high speed and an equalized turning moment on the crank shafts, fly wheels, if not wholly discarded will become harmless and inexpensive.

In the conversation before mentioned, we asked Mr. Dickie what he would do in the case of a single cylinder engine. "Don't make any of that kind," he said, and when we came to think over the various engines seen under construction at the Union Iron Works, during the last year, only two with fly wheels can be called to mind, and we think the sooner the various makers of steam engines set their cylinders vertical, employ not less than two, and leave the fly wheel off, the sooner they will be in line of what is to be future good practice.

At any rate people will not feel much inclined to purchase machinery that involves cast-iron wheels, moving at from 80 to 100 feet a second, something in nature very like a steam boiler without a safety valve.

The work of steam engines, or their resistance, as we commonly say, can be rendered nearly uniform in degree for all kinds of duty, or

Fig. 1.

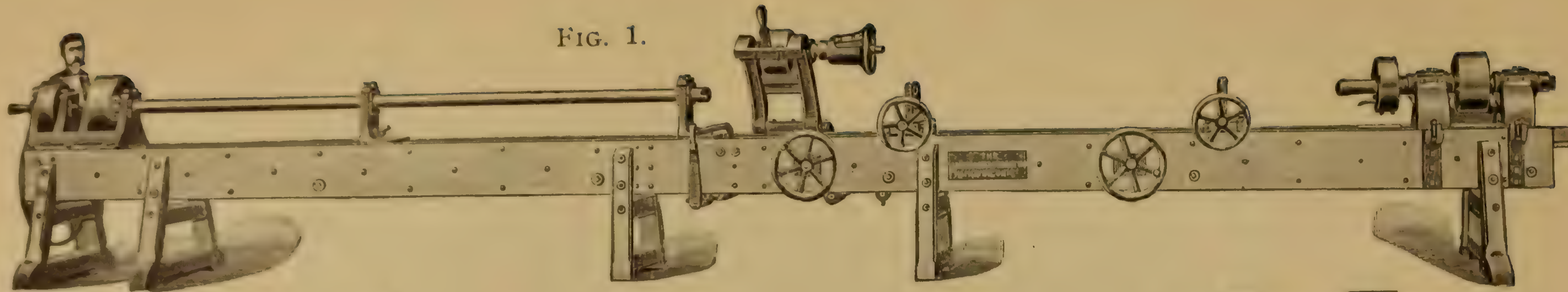


Fig. 2.

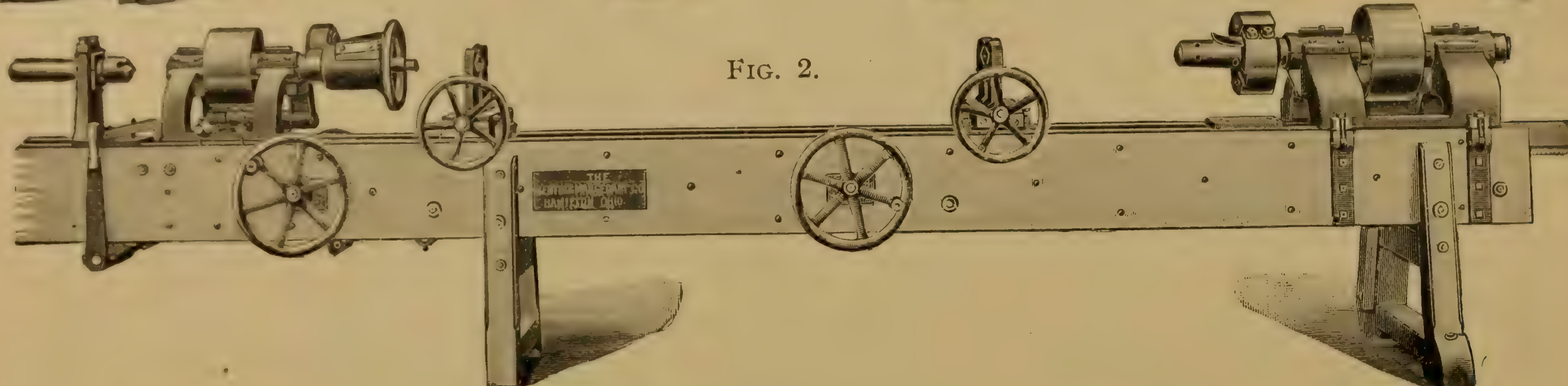
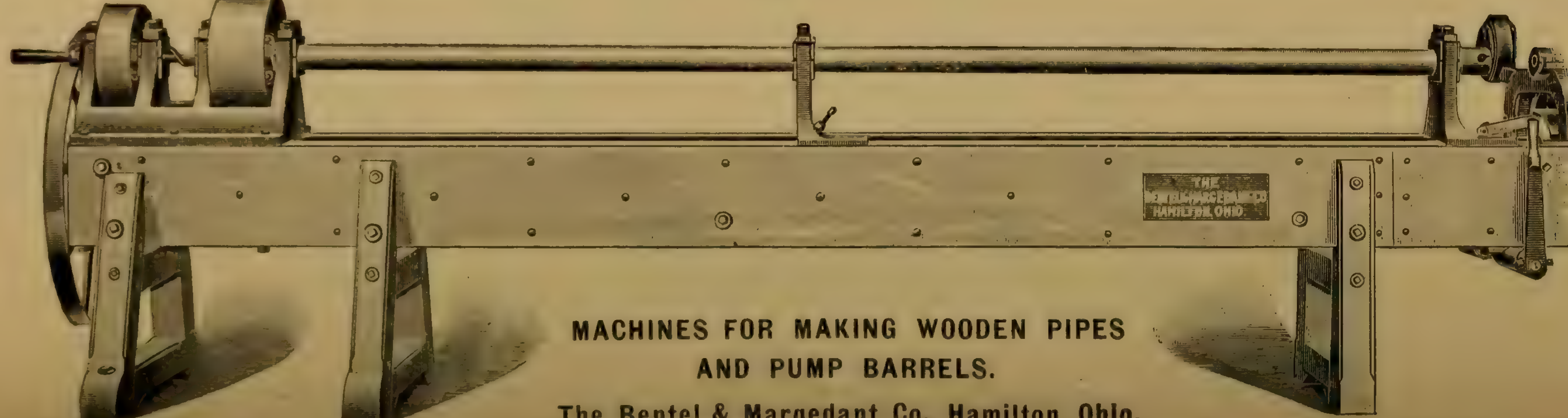


Fig. 3.



MACHINES FOR MAKING WOODEN PIPES AND PUMP BARRELS.

The Bentel & Margedant Co., Hamilton, Ohio.

within a limit that renders fly wheels unnecessary. This is the case now for most kinds of duty, even air compressing, this requiring as in the steam engine, two cylinders instead of one.

The functions of a fly wheel are happily drawing to an end, not from incentives of economy as might be, or from danger, which is becoming greater all the time, but in the regular sequential development and adaptation of the engines themselves.

It is tolerably easy to see how the danger comes about. The amount of iron, and consequently the main cost of a common fly wheel can be inversely as the velocity at which it is driven, hence there is a constant commercial pressure towards the danger margin, also a like commercial pressure towards the cheapest material — cast iron, so as Mr. Dickie recommends, the true way out of the difficulty seems to be in the direction of multiple inverted cylinder engines, which if they require a fly wheel need only a small one.

When fly wheels are required either for the regulation of speed or as first movers to receive bands or ropes, they can be of wrought iron or steel, as they are now being made on this Coast.

MACHINE FOR MAKING WOODEN PIPES, PUMPS AND PUMP BARRELS.

THE BENTEL & MARGEDANT CO., HAMILTON, OHIO.

Continuing the subject from last month we illustrate on the page opposite, drawings of a standard machine for preparing and completing wooden pipes, with the socket ends for connecting them together.

Fig. 1, opposite, shows a complete machine of the kind, and Figures 2 and 3 show the same machine in two parts, enlarged.

The head or boring end corresponds to the illustration last month, the added details in the present views being for forming conical sockets at one end of the tubes, and a corresponding nipple at the other end, so the pieces will fit together, interchangeably.

The cutter socket, seen in the middle of the machine in Fig. 1, and at the left in Fig. 3, forms the nipple by hollow-turning it precisely true and concentric. This cutter head or socket is mounted on a hinged frame that swings back when the pieces are being bored, which is the first operation, loosening the driving band at the same time.

When the nipple end is to be prepared, this cutter head is swung

into alignment with the other spindles, and the piece is fed forward into the cutters, a pin in the center giving stability to the spindle and holding the work concentric. The other socket end is then prepared by the rear spindle, also steadied by a central pin fitting into the bore of the tube.

Nearly all the operations are automatic, or as much so as is desirable, and the work can be carried on in a very rapid manner.

The machine, as will be seen, is of great length, and requires a very carefully made frame of dry wood, glued up flat, or laid vertically and bolted firmly together. For tubes to ten feet long the frame requires to be about thirty feet in length.

This machine is, as at first remarked, a standard one, that is, arranged for the making of common tubing, but is merely typical of various modifications for analogous work, such as preparing hollow porch posts or columns, hydrant or pump stocks, and other hollow forms in wood.

The base of the whole is the boring apparatus. This is made very constantly the same, but for the rest, the exterior it may be called, the company make machines of various kinds to turn the stocks in certain places or all over, to dress the square sections, cut slots for pump handles and so on.

The class comprises, as may be said, a complete set of implements for all kinds of hollow forms in wood, ingeniously carried out by the Bentel & Margedant Co., who have fortunately given many years of effort and attention to designing machines for work of the kind.

PATENT LAWS IN FRANCE.

The French patent laws with but little change have been in existence for more than fifty years. Amendments were made in 1856 and 1868, but not affecting the general statute. Subject matter for patent grants is the same as in this country and in England, except that medicinal compounds and "financial plans and schemes" cannot be patented.

The term of a patent is for various periods, but as the fees are the same for all terms, and the taxes the same for each year of the terms, patents are always taken for fifteen years, or to the end of a foreign patent on the same thing, which terminates the French one.

The French laws provide that the author or originator of an invention should be the applicant, but a patent taken out in France

by an assignee may be valid. The safest course is, however, to proceed in the inventor's name.

Specifications and drawings must be furnished in duplicate, one for retention in the French Patent Office, and one to be returned to the patentee.

The specification must be for one thing, or one invention; written in the French language, and must not have alterations, erasures or parenthetical matter, a good rule for all documents. The first year's tax of 100 francs must be paid when the petition is presented, and a similar fee each succeeding year.

There are no examinations as to novelty. This is placed at the applicant's risk, and the government assumes no responsibility as to his statements or claims. There is no extension of the time for paying the annual taxes in French patents, and no provision for amending a patent once issued, but "patents of addition" can be added to the original one to expire at the same time. The taxes for such additional patents are only 20 francs a year, after the first fees are paid.

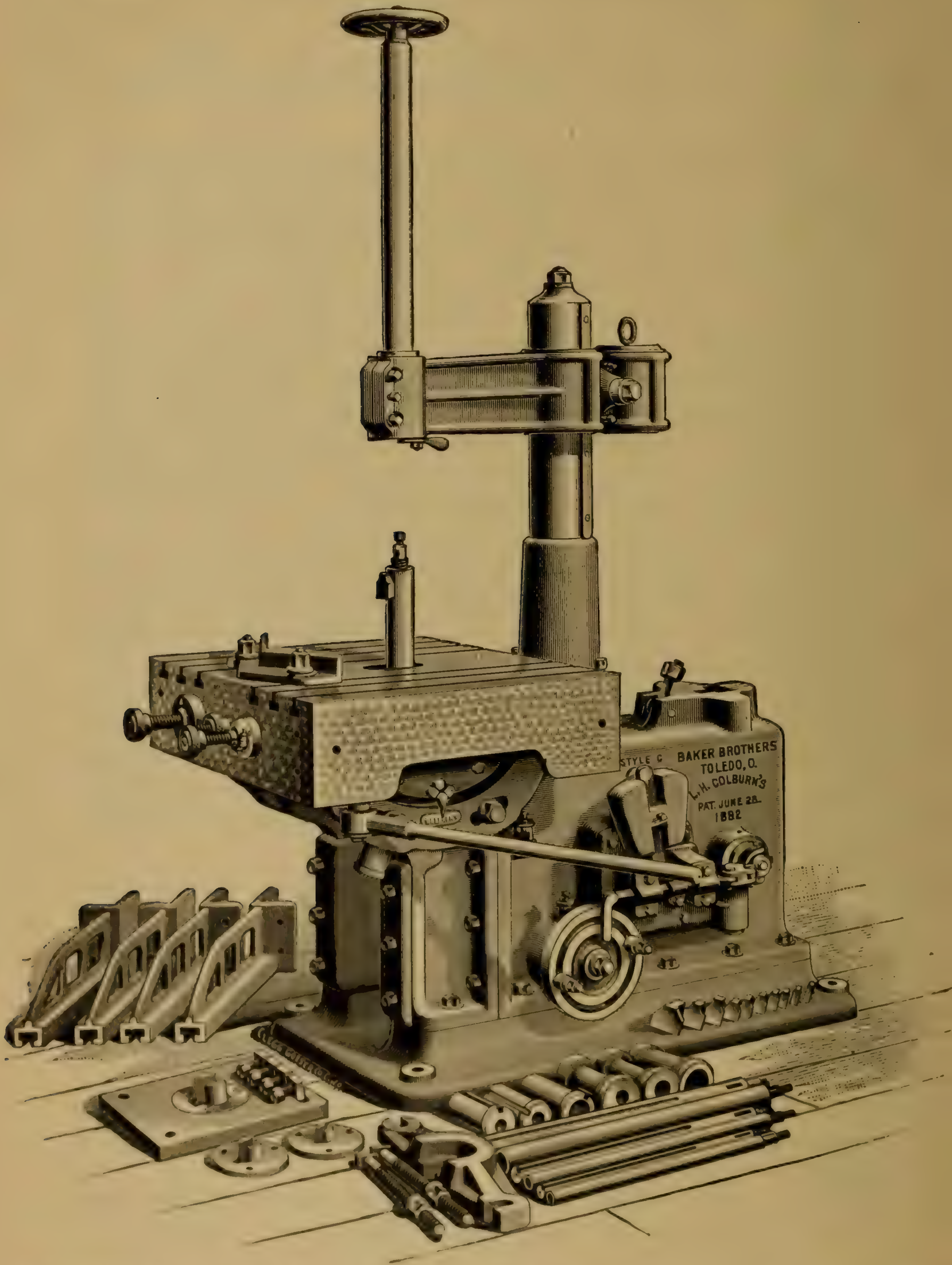
A patent must be worked in France within two years from the date of its issue, and such working must not cease for a period longer than two years. The cost of such working depends on the extent and nature of an invention, and especially upon the means taken for carrying out this provision. Failure to work a patent in France may not render it invalid if there are shown reasonable circumstances that prevented such working. French judges are not bound by precedent, as in this country and in England, and in the absence of definite provisions of the law use wide discretion in such matters, as *laches* of procedure.

Inventions patented in France cannot be made elsewhere and imported there by the patentee or his agents. The work must be done in France.

The remark above in respect to the power of judges applies to the interpretation of a patent and its scope, and whatever appears as new will be protected to the inventor even if he does not specifically claim it in set terms.

Patented articles sold in France must be marked *S. G. D. G.*, meaning *Brevete Sans Garantie du Gouvernement*, "Patent without guarantee of the government."

Assignments of patents and exclusive licenses require full payment of the taxes for the whole term of the patent.



KEY-WAY CUTTING MACHINE.—MESSRS. BAKER BROTHERS, TOLEDO, OHIO.

KEY-WAY CUTTING MACHINE.

MESSRS. BAKER BROS., TOLEDO, OHIO

The method of cutting key-ways by pulling action with reciprocating saws or flotes, was at first adopted for doing rough work rapidly, and was performed by cheap machines that lacked a good many functions required for accurate work.

It was found by experience in about twenty years' time, as is common in machine-tool improvements, that the method was not only the best for cheap work, but for the best work, more rapid and accurate than any other, so the machines began to improve themselves in various ways until now, as the drawing opposite will show they rank with other machine tools of the best class.

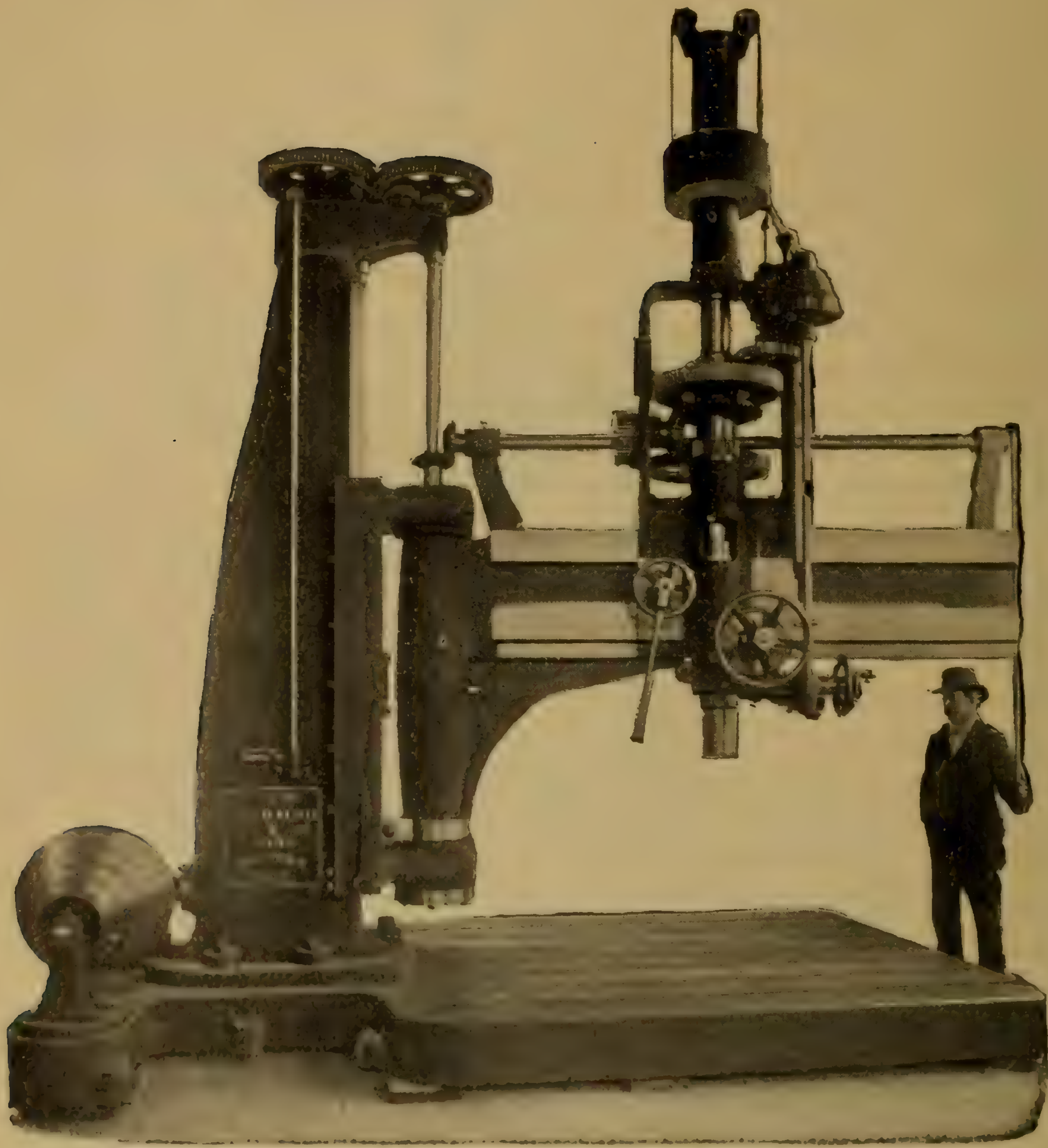
Not only this, the first machines were made for small work only, and not adapted to cuts more than three inches deep, the tools being driven by crank motion. Now the stroke is given by rack movement, and the flote tools have given place to single cutters, as shown in the drawing, operating like a slotting machine, and key-ways are cut in holes up to 36 inches in length. The machine shown has this capacity, but smaller machines are furnished by the same makers.

There are several novel points in the present machine. One is a top support for the cutter bar, shown disengaged in the drawing, and a shifting column to support this bearing.

In case wheels are of such a diameter that the rims will fall in the plane of the column, it is set back on the seat, seen at the rear end of the machine, and the horizontal member or radial beam is shifted to the second shell bearing at the end.

The advantage over a slotting machine for this kind of work is the better performance with a pulling movement of the tools, and in a support both above and below the work, also in the less cost of machines in the form shown.

The cutter bars and fixtures seen around the machine shows an extensive and convenient outfit for a wide range of work. Ohio is becoming the machine-tool State.



RADIAL DRILLING MACHINE.

C. H. BAUSH & SONS, HOLYOKE, MASS.

We some time ago requested Messrs. Baush & Sons, of Holyoke, Mass., to send us drawings of a typical machine of their make, to illustrate the method of gearing on the main spindle, instead of on some separate shaft, transmitting through the torsional elements of the machine and several pairs of bevel wheels, as is common in drilling machines of this kind.

Instead of sending one of their smaller and very symmetrical standard machines they have supplied the above illustration of a

very heavy special drilling machine, made for the United States Government for use at the Watertown Arsenal, and which may, however, have more interest to our readers than the smaller ones.

The machine illustrated weighs 22 tons, is 17 feet 6 inches high, and the bed plate 14 feet long. The spindle passes over work 7 feet high, and drills at 9 feet from the main column. The most notable dimension of all, however, is the spindle, which is 6 inches in diameter, and this is in correct proportion, such spindles being usually about one half as large as they should be.

The point to which we wish to call especial attention is that the work or strain passing through the four transmitting shafts from the cone pulleys to the spindle is only that of the first mover, the back gearing being placed on the spindle itself in the same manner that an engine lathe is geared. If this gearing was on any one of the first movers then the intense strains of the slow-geared motions would have to be transmitted through the bevel wheels, their supports and the intervening shafts, which would form a very complete spring or elastic abutment for the cutting strains, also would constitute these transmitting elements much the weakest in the machine.

It is remarkable that only a few among the various tool makers have adopted this common-sense manner of arranging drilling and boring machines. We some years ago clamped a lever on the spindle of a radial drilling machine to measure the degrees of arc the spindle could be moved through by twisting it when the back gearing was locked. The result is not now remembered, farther than it was a matter of much astonishment, and we are glad to see some hopes of a better arrangement of such machines in future.

WATCH-MAKING BY MACHINERY.

The New York *Sun* some time ago published an account of how the machine-made watches at Waltham, Mass., had to pass through the hands of an "adjuster," who was paid an enormous salary for his services. As this did not correlate with our ideas of machine functions, we addressed a communication to the Waltham Watch Co. asking for information. This letter was courteously replied to by the assistant superintendent, Mr. E. A. Marsh, and his communication will have much interest to our readers. We have his consent to publish the technical portion of the letter, as follows:

TO THE EDITOR OF "INDUSTRY."

Sir:— By the "American system" of watch-making, watch movements are manufactured in large numbers, and are substantially uniform in dimension, so that, with the exception of some of the very delicate portions which constitute the escapement, they are interchangeable. The adaptation of the balance spring to the balance is a matter of exactness, and allows of no latitude exceeding the ability of the regulator to correct, and in practice very little is allowed to be left for such correction, which work is naturally called "regulating."

In all ordinary watches the balance should vibrate exactly 18,000 times each hour, 17,999 or 18,001 will not suffice, for the loss or gain of one vibration means nearly 5 seconds lost or gained in a day, or 2½ minutes per month. By the use of ingenious machines it is now possible to mutually adapt balances and springs to each other, so that when they are placed for the first time in the otherwise completed watch movement they are found to be "just what was wanted."

If the members composing one or any given number of watch movements were made with a specially high degree of finish, or of special material designed for a high-grade movement, the final performance of the completed movement must be such as to fulfill the original design. But a good many things are demanded of a high-grade watch. In the first place it must be indifferent to the weather, that is, it must maintain a uniform rate in heat and cold. This involves what is called "temperature adjustment," which, being an exact science, requires definite treatment, and is comparatively a simple matter. It should also be in condition to give a uniform rate, whether just "wound up" or nearly "run down." This involves what is called "adjustment to isochronism."

In a piece of mechanism as delicate as a watch, and in which by the successive increase of speed in the moving parts, one turn of the main wheel gives 126,000 turns of the balance, the ultimate amount of force available is very minute. It is therefore important that the element of friction be reduced to the lowest possible limits. It might be found that a watch would show a slightly different rate when lying in one position from that shown when in an opposite position. Such a change might be due to varying friction, or possibly to a slight imperfection in the poise of the balance. The discovery and removal of such imperfections constitute what is known as "adjustment to position."

It would be a correct statement to say that every watch possesses an individuality or "character" peculiar to itself. The work of the adjustor is to discover and remove the minute errors, which can only be found by a series of accurate tests. This would be in the nature of an attempt to destroy the original characteristics of the watch by eliminating the causes of its imperfect action. Of course the most desirable and ideal watch is one whose original character is so perfect as to require no corrections whatever. Some movements

prove to be of this kind, but it cannot be predicted of any given watch movement that when the various parts which compose it are assembled their action will be perfect.

The standard of requirements for watches has been raised within a few years by the adoption by the leading railroads of the United States of a systematic and exacting time system, which compels all employes connected directly with train service to carry watches of a specified grade, and whose maximum variations of rate shall not exceed one minute per month, and in most cases only thirty seconds variation is allowed. To successfully meet these exacting requirements, accurate tools and machines on the part of watch manufacturers are demanded, and the exercise of constant care in their use; but many thousands of watches are produced whose performance is remarkable, considering the unfavorable and constantly varying conditions to which they are inevitably subjected.

Very respectfully,

WALTHAM WATCH COMPANY,

E. A. MARSH, *Asst. Supt.*

Waltham, Mass., Nov. 7, 1895.

COX'S COMPUTING APPARATUS.

Mr. William Cox, C. E., of Stapleton, New York, whose computing devices of one kind or another, we have several times mentioned, has organized a regular manufacture of these instruments, and prepares them for computing the capacity of pipes, the flow of liquids and gases, the mensuration of earthwork, capacity of beams, and so on, based on logarithmic formulæ. These devices not only save much time in making computations, but secure accuracy, and are valuable for checking and proving work done in the ordinary manner.

One of the latest modifications produced is an improvement on the old form, to solve by Kütter's formulæ all kinds of problems relating to the flow of water in pipes, and to a considerable extent in open channels. One adjustment gives simultaneously the velocity and volume of discharge for pipes, and is, no doubt, now as perfect as possibly can be. An engraving of this device, prepared to accompany this article, proved to be imperfect, and has to be omitted.

Lists and descriptions can be had from the inventor at Stapleton, N. Y., or the Cox Computor Co., which is the name of the business as now organized.

THE WRIGHT IRRIGATION LAW.

However regretable it may be, we strongly suspect that the United States Supreme Court will confirm Judge Ross' decision respecting the "Wright Law," as it is called, regulating irrigation districts. This decision, it will be remembered, was based on two propositions: that the assessments under this law are unconstitutional, because of taking or condemning private property for a purpose not public, and that such deprivation or taking of property was done without due process of law.

Either of these points are vital if maintained, and after reading such arguments as are adduced to show "public use of water," or its public object, and also in respect to the powers and privileges accorded to those assessed in irrigation districts, we are of the opinion that the United States District Court will be affirmed.

There seems to be a mistake in assessing "real estate" instead of "land," that is, improvements on the land, which may not require the water, and the value of which is not affected by it; also in the fact that compulsory assessment is not based upon hindrance or damage to those who have combined and desire to provide the water, but on a common good, to which people as citizens are not obliged by law to contribute, however commendable it might be for them to do so.

There is a wide and justified dread on the part of people, especially among farmers, of powers exercised by associations or corporations, and a hearing before supervisors who have not even the power to exempt land or real estate from assessment is very wide of what is meant by process of law. We have abundant faith in some proper legal means to cause or permit coöperation in providing water for irrigation when community action is necessary, and believe this is possible without the present powers of assessment embodied in the Wright Act.

THE BOND METHOD.

Mr. Edward Atkinson, writing recently on railway construction in this country, says:

"What would have been the verdict of the community upon any industrial enterprise except railways, such as the construction of a textile factory, iron works or workshop of any kind, had the plan

been presented for raising money enough to cover the cost of construction on first mortgage bonds, the enterprise thereby beginning its existence with a debt equal to the cost of its entire plant, then in addition second mortgage bonds at a heavy discount for about an equal sum, and then preferred and common stock, so that the undertaking would be represented in the market by what are grotesquely called "securities," amounting to three or four times its true cost? Had any enterprise except the construction of a railway been presented in such form the promotors would have been deemed either knaves or fools by the community, especially had they already earned and become notorious for deserving the first title. Yet such was the first basis of a large part of the railway corporations which are now in the hands of receivers. Credulous and speculative people in this country, and yet more in other countries, have wilfully invested their money under these conditions. There has been little difficulty at any time in the last twenty years in making a perfectly safe selection of railway bonds for permanent investment, and there has been little difficulty in choosing railway stocks for investment under the management or men of the highest repute, subject only to the ordinary contingencies which accompany the conduct of any large undertaking."

This bond matter has become rascally and offensive. The idea of borrowing money from some one else without security and setting out to manage its investment without the owner of the capital having any voice in the matter is the coolest proceeding that can be imagined, yet it is a common idea of "getting up a company" at this day, not only railway companies, but sometimes industrial and other enterprises.

LOCAL NOTES.

Be as careful as one will, there are always traps to fall into. Last month we had some remarks upon a fall of 75 feet that existed in the Chicago drainage canal between Chicago and Joliet. The editor of the *Engineer and Boiler Room*, Chicago, writes as follows:

"You say the fall of the Chicago Drainage Canal between Chicago and Joliet is 75 feet; this is an error. The fall is nearer 15 feet on the present canal. There is a lock at Lockport, where water power is in use. This is the only fall on the route."

There is about to be tried an experiment on a large scale for impounding the underflow water in Coyote Creek, that enters the Santa Clara Valley near Los Gatos, and then flows in gravel strata for a distance of seven miles. The creek, except in high stages, is all absorbed in half this distance, and the purpose is to excavate a

parallel pool or reservoir along the creek for more than a mile, sufficient to afford a supply of 25,000,000 gallons a day through the summer season. The work is now in process under Mr. G. F. Allardt, C. E., of this City, and contracts are being made for irrigating valley lands, which lie one hundred feet below the head. This scheme, which has the approval of Col. George H. Mendell and other competent engineers, is one of much novelty, and, if successful, of great importance to the State, because the circumstances are much the same as with hundreds of other streams that flow into gravel beds at the edge of valley plains.

The Keystone Boiler Works, in this City, are making for steamers to be used on the Amoor River, in Siberia, a number of steam boilers of the locomotive wood-burning type, four of them 60 inches in diameter, and two 54 inches. These are to be placed in stern-wheel steamers to be built here, and are of the highest class both in material and workmanship. The company have also in hand marine work and a number of local contracts that are taxing their facilities and room, which can be taken as a sign of increasing trade here in an engineering way. In fact the volume of work in the various engineering and machine works is if anything ahead of other industries, and as this product is mainly agencies for farther industry, the sign is a good one. The Keystone Company have also been making a number of their patented retorts for heating purposes in food packing, an ingenious and convenient contrivance for the purpose.

The failure of the railway commissioners in this State to regulate the rates for carrying freight brings forcibly to mind the folly of keeping fifteen thousand men, State and Federal, at work making laws that are not needed, and if needed cannot be enforced. This railway commission matter, for example, has proved nothing more than a method of saddling three salaried officers on the taxpayers of this State for sixteen years past without the least advantage, and, as one may say, without effort toward action. Municipal legislators will add another fifteen thousand or more to the law-making force in this country, busy enacting ordinances that are without effect. In 1881 the corporation in Chicago passed an ordinance assessing a license tax of $50 a year on street cars, not a dollar of which has ever been collected, but the ordinance stands, and now to create some legal fees a suit is to be brought to collect $2,500,000 of accrued taxes. Every one knows that the amount collected except in bribes will not pay for the stationary in the complaint.

Our friends of the *California Architect* continue these dull times to not only maintain but improve their valuable publication. Architecture, including to a great extent the art ornate, demands in its literature a corresponding taste and "make up," a standard maintained in a full degree by our contemporary. This is not, how-

ever, the feature that we find most reason to commend in the *Architect.* It has a fearless habit of attacking what is wrong, and promoting what is right, in all matters involving problems of an ethical nature. The plates, four in number, detached and suitable for mounting, are worth alone to an architect, and to others, a good deal more than the subscription price of the journal. It is not often that we devote space or remark upon what should at any rate be common knowledge, but we have some pride in the *Architect,* as no doubt have its publishers.

Messrs. Howard and Cuenca, publishers of *Revista Hispano-Americano* have complained to the Manufacturers and Producers' Association of this State respecting the Pacific Mail Company collecting the freight charges in advance on goods sent to Central American ports. A committee of the Manufacturers' Association laid this matter before the general agent of the Pacific Mail Co., who informed them that as goods delivered in these ports passed into the hands of the customs as soon as landed, and as the coin of the different countries varies in value, the company had to collect freight in advance, which the committee reported as not affording just ground for complaint. We cannot agree with the committee. The same circumstances exist in nearly all countries, this one included, and no such rules are required for collecting in advance charges for carriage. If there are peculiar circumstances in the case these could be met, no doubt, by other means than those adopted, which savor more of convenience to the company than the promotion of trade.

If the Corral Hollow coal mines, in Alameda County, almost at the door of this City, are as reported, or anything near as reported, the effect should be to cheapen coal here; not to bring it to three or four dollars a ton for good coal, as people claim, but to cause some reduction. Explored veins are said to contain 20,000,000 tons, and that $800,000 has been spent in such exploration. The company are building a railway to tide water at Stockton, and the fact as a whole is one of great importance to this and other places reachable by water. The most significant fact of all is that there is no one around selling shares. The chief promoter and owner, Mr. Treadwell, to use a local expression, "put up the coin," and went to work on his property. This is more than significant, it is absolute assurance of good faith, and every one by every means should encourage the enterprise. The coal has been tested and found good, so the whole scheme seems to be one of good faith, rare enough at this day of ours.

The Abner Doble Co., of this City, have contracted to furnish the Los Angeles Electric Railway Company with an 800-kilowatt generator for their lines. The generator, weighing 14,000 pounds, will be run at 80 revolutions per minute, driven by a compound

engine of 1,200 horse power, made by the E. P. Allis Co., of Milwaukee, Wisconsin. This generator, made by the Walker Manufacturing Company, of Cleveland, Ohio, it is claimed will be the largest one ever erected on this Coast, requiring about 900 horse power. An efficiency of 95 per cent. is guaranteed by the makers and contractors, that is, the dynamo is to absorb but 5 per cent. of the dynamic force in passing through it, which if possible is also wonderful, and is little more than the usual coefficient of mechanical friction.

The Technical Society held their regular meeting for December on the 6th ultimo. Mr. E. Everetts, of Tacoma, Washington, was elected a member of the Society. A committee of five members was appointed to nominate officers for the ensuing year. This committee at a subsequent meeting agreed to present the names of the present incumbents throughout for both executive officers and directors, except for the treasurer, Mr. Geo. F. Schild, who has removed from the City, his brother, Mr. Edward T. Schild, being substituted. The paper of the evening was by Mr. John C. Pelton, Architect, of this City, the subject being the "Released Asheler," submitting for discussion the attachment of slabs of marble to the exterior of building walls in which the facade is simply ornamental to the extent of a marble or other finish. There was an interesting discussion, and the paper will be submitted for publication in the Journal of the Association of Engineering Societies. There is no need of changing the present officers; one year's service only prepares them for the discharge of their duties. The ticket will therefore be, President, G. W. Dickie; Vice-President, J. W. Curtis; Secretary, Otto von Geldern; Treasurer, Edward T. Schild.

The conduct of a war is a technical matter. The making of war is a fool's matter, a thoughtless and illogical manifestation of the savage element that wants to smash some one. The President's late message to Congress is estimated to have cost by depreciation in American securities a billion of dollars in three days, and it will cost a good deal of humiliation to all thinking people who are true patriots. It stirred up the fighting contingent, who think the boundary of Venezuela can be settled by slaughtering people in Canada. One thing it would settle, and that is a mortgage of thousands of millions on the industries of this country. Those who have "seen" war and traced its demoralizing results can have no sympathy with such savagery. They will remember Andersonville, Libby and Camp Chase. Many of them, the writer of this among the number, can point to the graves of more than half of their schoolmates killed in the War of the Rebellion. One true statesman is worth more than the army and navy combined in removing the issues that are made an excuse for war.

COMMENTS.

Rear Admiral R. W. Mead (retired) and some of his colleagues, not retired, should be formed into an executive cabinet to manage this country, fight Great Britain, acquire possessions all around, and construct the Nicaragua Canal. This is what Admiral Mead said to the Society of Naval Architects and Marine Engineers at the late meeting in New York:

"The Society should petition Congress at once to do something "for the Nicaragua Canal. That canal is bound to be built, and "this country could not contemplate unmoved any possibility of its "construction by foreigners. The time has come when this country "must 'reach out.' We wanted San Domingo, and should have "had it, and would have had it, ere now but for blind politicians. "The time has come for this country to say to other parties on the "other side of the water that if there was any land lying around "loose on this side the United States was (*sic.*) the residuary legatee "of that land."

The Society, under the lead of Charles H. Loring, proceeded to squelch a resolution of the Jingo Admiral by a vote of 27 to 14 against the report of a committee to memorialize Congress. These patriots of the "line" are becoming troublesome and ridiculous.

The American Society of Mechanical Engineers did a graceful act at the Annual Meeting last month in electing John Fritz president of that body for the coming year, and the only comment that we can think of is that it is a wonder that the same thing was not done before. Father Fritz is 73 years of age, and so well known by various worthy acts and accounts of his labors in the iron and steel industry that no personal mention of him is required now, unless it be that he has worked his way to this distinction and others by "work," accomplished work. All favor and nearly all acknowledgment of his great work came after its "completion." It was hard fighting, against odds for fifty years, going up hill all the time, an inch at a time, so to speak, but incessant hopeful effort led to a success that will invite emulation for generations to come, and with it all perhaps not one act to recall that is not of pleasant memory.

Illinois has spent going on to four millions of dollars on her Bureau of Labor Statistics, and it may prove in the end a good investment, because the people, if they have any sense of justice or the spirit of human equality, must soon rebel against an iniquitous system of assessment, as shown by a late document from the Labor Bureau. We do not at this time propose to go into the subject. It is too lengthy for short discussion, but to find the assessment of Indiana $450,000,000 more than Illinois gives a clue to the circum-

stances. The above-named report on taxation we expect to study for some time to come. It is an able exposition of the nature and results of indirect taxation, that is, taxes that by the assessed person are passed on to some one else, the consumer. If a man is taxed on his money, income, or land he must pay the tax, but if he is taxed on implements, imported goods, or in any way that he can add the tax to his sales, he pays nothing whatever, only as he consumes commodities. Under such a system the rich grow richer and the poor grow poorer. This is what the Labor Bureau in Illinois has found out and says.

There is in Philadelphia a commercial museum, which from its stated objects is to promote foreign trade. This seems strange. The "Pennsylvania idea" is to not do any foreign trading. It induces importation and disturbs domestic trade. Carey's *Social Science* explains this, and so did a professor of political economy in the University of Pennsylvania some years ago, who taught that such trade was corrupting, and not to be encouraged, besides to send goods into a foreign country is to infract there the principle of home production. There must be a great change of views in the Quaker city on this subject of foreign commerce.

The J. A. Fay and Egan Companies at Cincinnati, Ohio, have sent out an agent to South Africa to represent their business there, which is a "departure." Americans are proverbially backward in such things, and it is not to be wondered at, because there is continual preaching of the evils of foreign trade as an infraction of the protective idea. There must be a considerable demand for wood-working machines in all new countries where building is a principal interest, and we trust the companies named will find their enterprise rewarded in a full measure.

The *News Advertiser*, of Vancouver, B. C., noted in November last that at that time a train of seventeen cars was on its way to this Coast from Ontario loaded with canned vegetables. This is one of the anomalies of trade, and is also an example of various things that occur lower down on the Coast. The climate and soil around the Sound, especially to the southward, is peculiarly adapted for vegetable culture. As a rule there is no freezing until December, and near there is an extensive example of food packing, at Astoria, so one would think the people would at least raise their own vegetables and preserve them. At Paraiso Springs, in Monterey County, there is produced on ten acres or so all the fruit and vegetables consumed in a large hotel, and nothing of the kind bought, while on large farms near by such things are procured in the city.

The universal nature of science and technology was well illustrated by the late meeting in Zurich, Switzerland, to consider uni-

form methods of testing materials, of construction and of analysis. This country participated to the extent of sending an officer of the United States Army Corps, Captain O. M. Carter, and the American Society of Mechanical Engineers also sent a delegate. There were about 300 delegates present from all the various industrial centers of the world. The spirit of universal effort and counsel adds one more agency to the sentiment that opposes jingoism and war. Trade and moral sentiments are principal, no doubt, but all the time some progress is made toward eliminating the old animal instinct of fighting among the tribes. These international meetings of whatever kind contribute something to peace. Few people think of the bearing in this direction, but it is palpable all the same.

Messrs. Pearson & Sons, of London, the contractors who finished the great drainage canal for the valley and City of Mexico, have been awarded a contract for removing 4,000,000 cubic yards from the harbor of Vera Cruz. This is the largest contract of the kind on record let to one firm. The inner harbor area when complete will be equal to 380 acres, with water 28·5 feet deep.

The Pullman Palace Car Company have published their annual statement, in which appears total earnings $8,547,624, disbursements $7,137,243, surplus $1,410,390. In the disbursements are included dividends on stock, $2,880,000, which added to the surplus for the year shows a profit of $4,290,390. This, about 10 per cent., is earned on a nominal capital of $30,000,000, which every one knows, or believes at least, is about a fourth of this amount, and that the profits are about 40 per cent. It would be interesting to see the returns for taxation on the $62,792,958 set down as the company's assets. It is also time to compare the statement with Mr. Pullman's showing in evidence before the courts in 1894 as to the losses of the company, and this is the main interest that alludes to the matter aside from the tax assessed for the cars. The railway companies all over the country have created the Pullman service the only first-class one on their lines, that is, have lowered the other service until people are compelled to patronize the Pullman carriages.

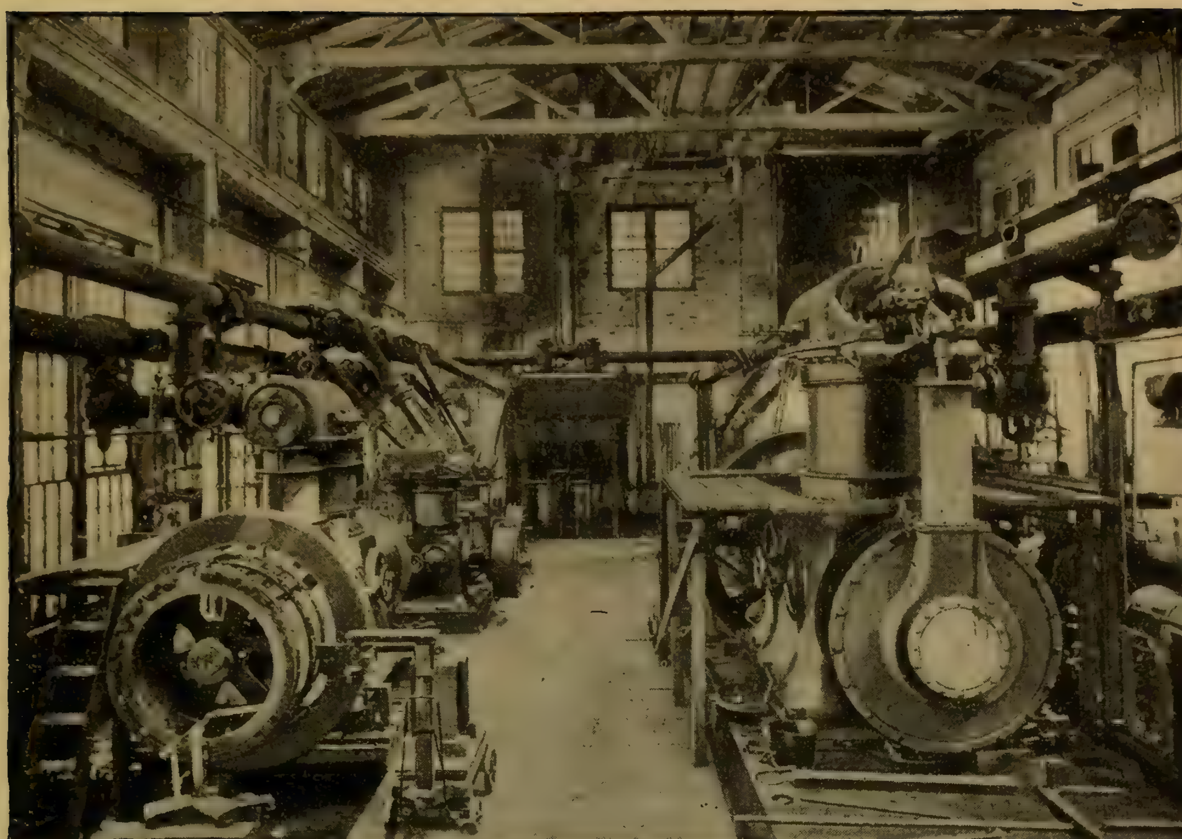
The *Mining and Scientific Press*, San Francisco, has a notice of the closing of the great arc line from Cape May, N. J., to Point Arena in this State, commenced twenty-four years ago by the U. S. Coast and Geodetic Survey. We travelled some years ago with an officer who had been engaged for some time on this work, and his accounts of it, as remembered, disclosed a very uncomfortable kind of service, full of privations and danger. This line was determined by triangulation from tops of mountains, often far above the timber line, where the officers worked out their geodetic problems, but being "technical fellers" they need not expect the reward of a novel writer, a politician, or even an astronomer, because their work is

useful and has a practical object. It is to be regretted that so little honor and acknowledgment attaches to duties such as Simon Hassler, Prof. George Davidson and Chief Eimbeck have performed. No one person in a thousand ever heard of such a work, and even the U. S. Geological Survey, who will use this base line in their work, will not be likely to mention it in their reports.

The United States at this time presents an economic or commercial anomaly. Agriculture is depressed, prices are low for many staple commodities, indeed are not high for any of them, and there is depression all over the land in some branches of trade, while others are abnormally active. The iron works are all busy, so are manufactures of iron as a rule, but the timber interest is by no means active. Expenditure for pleasure and luxuries is commonly looked upon as an indication of the state of business, and at no past time has there been a more lavish expenditure in feasts, yachts, horses, and foreign travel. The exports of manufactured commodities from this country, it is predicted, will exceed $200,000,000 in value this year, still there are hard times, a want of employment in many branches that should be flourishing. The circumstances refute in a great degree the theory of the interdependence of industry, also as we believe goes to show the marked effect of foreign trade in many lines.

The principal element in the main transcontinental railways is the land grants or subsidy given to the lines by the General Government. The Northern Pacific Railway, for example, a corporation of unsavory history, got 47,000,000 acres, and has sold for cash out of these lands to the amount of 38,000,000, which is about all the increment of value that ever took place in that corporation. People who can remember the default on the Jay Cooke bonds that started the great panic of 1873; the Villard muddle that followed in six years, and the receiver's manipulation of two years ago, will be quite prepared to hear that the present managing powers, whatever they may be, want $9,000,000 of money for betterments or maintenance of the line, it may be called, also may be called lootings of the earnings of the property that must now be replaced. The road should be turned over to "Jim" Hill now; he will, no doubt, have it in the end.

The German people are credited with a faculty for abstract thought and a weakness for pure science, but we think for late years their incursions into the practical commercial world are equally marked. The machine makers in Saxony and elsewhere, 60 firms, having 27,000 workmen, have combined to promote foreign trade in their products, and now have an agent in Peru and Chili and one in the Transvaal. They also expect to send agents to Brazil and Argentina. These agents are skilled engineers, and the business assigned to them is treated as a separate department in the works

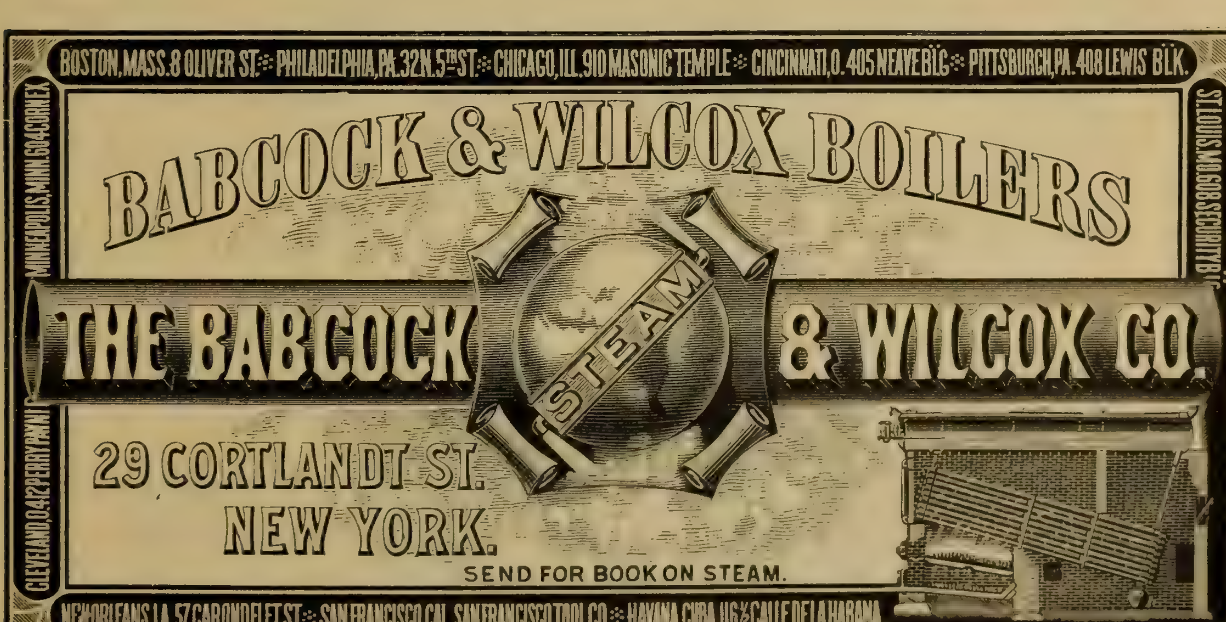


TESTING ROOM.

ALL WESTINGHOUSE ENGINES, from the 5 H. P. "JUNIOR" and "STANDARD" to the 700 H. P. Compound, are subjected to **RIGID MECHANICAL AND ECONOMY TESTS,** before leaving the Factory.

THE WESTINGHOUSE MACHINE COMPANY

PITTSBURGH, PA., U. S. A.



CHARLES C. MOORE, Pacific Coast Agent, 32 FIRST ST., S. F.

---

represented. This latter contains a broad hint. Suppose the works here were to combine and send agents to some of the principal cities in South and Central America, and keep a separate account with this business, crediting a commission on the goods sent to the agent, and charging all expenses to the same account.

Harlan & Wolff, the great shipbuilders, in Belfast, in three months following the 22d of June, this year, launched six steamers, the collective tonnage of which is 45,530. The *Georgic* was the first one in the lot, a White Star steamer that runs to New York. The other vessels were all for British lines. This is a wonderful record, nearly 600 tons a day during the three months. Making a locomotive a day, or several of them for that matter, is a small matter in comparison.

The Secretary of the Navy should issue an order that line officers should cease writing magazine articles. Such matter is commonly bombastic, and frequently illogical. A man who is trained in the idea of destroying people and property is not likely to be an authority on ethical or other subjects of an abstruse nature. No one can complain of their ideas, taken from a training and environment that has for an ideal the destruction of people and property, but is neither the common nor best sentiment among reading people.

In Mr. Dickie's address on the taxation of shipping, which we publish in this issue, there is a point that should at once be acted upon by ship owners, the legality of collecting taxes upon property the functions and earnings of which lie mainly out of the State, that is, foreign and inter-state shipping. The Federal laws are supposed to be uniform, and if Pennsylvania cannot, as Mr. Dickie claims, tax such shipping, how can California do so? They hastened there to remove the tax when it was found illegal or not collectible, and this seems a short road to reform here. The Hon. Eugene T. Chamberlain, U. S. Commissioner of Navigation, has recently very carefully examined the laws bearing upon the taxation of shipping, and, as we remember, came to the conclusion that the States possessed the power of levying such taxes, but there is no doubt of the circumstances at Philadelphia in so far as making that a free port.

Mr. J. W. Gates, of the Illinois Steel Co., commenting on the purchase of 10,000 tons of steel rails from a Sheffield firm, England, for the San Joaquin Valley Railway, says: "The English are able on the ground of lower cost, *which is solely in labor*, to produce and sell their rails at the present time at $23.14 per ton." The Chicago price is $29.00, and the freight from there being $13.44 per ton makes the price here $42.44 against $33.23 per ton for English rails, but this is not the point we want to direct attention to, it is the italicized

line above. The old story, a political dodge to bolster up the $7.84 duty on steel rails. We can find plenty of people that will bet with Mr. Gates any amount, that his works, the Carnagie Company and the Johnston Company are producing steel rails at a less labor cost than is Cammell & Co., of Sheffield. It is not the labor; it is taxes, water, fuel, buildings, cost of plant, running expense, and a dozen more things that result from enhanced values, at least 40 per cent. more than in Sheffield. The labor in the rails is no more, and, as we believe, is relatively a good deal less.

To Portland for $5.00 and Vallejo for ten cents looks like a case where the public gain by competition, but it is no such a thing, except in a fleeting sense. Such a cut in rates means only the value of monopoly. This discount in money will all have to be paid back some time, either by the public, which is most probable, or by the contestants, which is now being done, that is, they are advancing it just now. The fare to Portland should be about $12.00, and to keep it at $20.00 is worth a struggle, such as is now going on. Whatever disturbs normal or natural prices is bad. Prosperity depends on permanence. Overcharges invite competition, and cut rates are a result of over rates.

Eugene Langen, known in connection with Dr. Otto, Otto & Langen, as the founders of the Otto Gas Engine Works at Deutz, opposite Cologne, on the Rhine, died recently. He was president of the Otto Gas Engine Company, the parent establishment at Deutz, and a man of much distinction in Germany as the promoter of this great industry, and others, including beet sugar manufacture, in which he was largely interested. Herr Langen visited this country in 1894, at the time of changing the Otto Gas Engine Works, at Philadelphia, from a firm to an incorporation. He was very wealthy, and more than almost any man of his time employed his capital in enterprises that benefited his fellow-men, receiving decorations from the German Emperor for his distinguished services to industry. The Otto gas engine was, however, the greatest scheme of all, because at the close of this century the gas engine will no doubt be, if it is not now, the greatest fact in motive power that has occurred for a hundred years.

There was recently a meeting and discussion in a society for promoting engineering education, held at Springfield, Mass., on the subject of engineering formulæ and the use of uniform symbols. It is high time some common sense was applied in this matter. We have on all sides discussions and effort toward uniform standards, and here where most of all needed there is absolute chaos. The pedantry of mathematicians is proverbial, and its worst phase is in assuming special symbols, usually Greek or other unknown letters, and different from every one else. A very few have by the force of circumstances become constant, but there are not many. No one can

CENTRIFUGAL PUMPS

Construction, Operation, History and Examples.

BY JOHN RICHARDS.

TWENTY-THREE ILLUSTRATIONS.

In Cloth Binding, postpaid *$1.00*

CONTENTS.

SECTION I.—CONSTRUCTION AND OPERATION.

SECTION II.—HISTORY OF CENTRIFUGAL PUMPS.

SECTION III.—APPENDIX.

INDUSTRIAL PUBLISHING CO.

40 CALIFORNIA ST., SAN FRANCISCO.

realize until the matter is specially considered, the impediment thus set up to students, readers and every one who has occasion to analyze computations. The saving in space too is an important matter, because the notation that must be given with formulæ written with arbitrary symbols, is commonly as long as an equation.

People look at the contract price of war vessels with amazement. For example, the *Indiana* cost $3,060,000, but this is not the whole cost, is indeed but one half of it. The gun mountings, guns, armor, trials, etc., foot up $3,220,000, making a total of $6,288,000, but this is not all. The total estimate until the vessel is in commission is $7,000,000. Just think of it, and then in each year an expense of maintenance, a million more, all to satiate the old animal instinct of war and destruction. How can it be otherwise than oppressive when the realms of human effort are thus swallowed up in such useless and barbarous ways? It is a race between "the powers," each trying to bankrupt the others.

The English people, and also the Americans, are continually disturbed over the progress made by the German merchants and manufacturers in Asia and Africa, the English claiming that they build up commercial connections that are soon occupied by Germans. At Hong Kong the German people have established a number of permanent factories; one for matches, another for soap and a third for treating feathers. The common cry is "technical education in Germany," which we do not believe to be the main cause of their success. It is more likely to be good faith in their operations.

ENGINEERING NOTES.

From a list of the de Laval steam turbines or impulse engines it seems that the weight is from 30 to 57 pounds for each horse power. For example, an engine of 5 horse power weighs 286 pounds; 10 horse power, 440 pounds; 15 horse power, 517 pounds; 30 horse power, 902 pounds. The latest tests made in Sweden show a steam consumption of 19·8 pounds per horse power per hour, steam at 52 pounds pressure and 26·4 inches of vacuum. We are at a loss to know how in the late tests made at Purdue University the steam consumption was twice as much. The best authority in respect to these engines comes from France and Switzerland, where water or steam consumption is guaranteed below what good piston engines can attain.

The custom of having railways laid in the streets of towns and cities, common all over this country, will some time in the future prove a serious matter. It will not be logical to assume that rail-

ways should keep their ways off the street, but there should always be a legal provision that will compel the removal of railways, and everything else that obstructs or impedes the traffic in the streets. Philadelphia in former times dealt charitably with the railways. The two principal lines had stations within less than a mile of the south side of the city on a principal street and a main avenue, Fourteenth Street was covered with turn-out ways, which the citizens in their wrath dug out one night about thirty years ago. Since then by persistent effort one street after another has been cleared, but the work will last for half a century to come. Buffalo, New York, has just now had to deal with the same problem, and there is six millions of dollars to spend in that kind of work there.

Mr. E. Kolben, of the Oerliken Machine Works, in Switzerland, has written an essay on worm or tangent gearing that should be translated into English. There is a great want of information in respect to such gearing, not in its theory, but in constructive features, and especially its operating conditions. The essay above mentioned contains the result of some experiments, showing a loss of only 13 per cent. by a brake test with tangent gearing, which is no doubt correct. The test was made under a resistance of 21 horse power, and at a speed of 1,500 revolutions per minute for the screw. These experiments were made by Prof. Stodola at the Zurich Polytechnic with gearing made at the Oerliken Works. The wheel was of bronze, and the pinion or screw of steel. We note here in some cases pinions made of bronze, which is expensive and useless. The tenacity of material is required in the wheel and not in the screw. The latter does not break, and in conforming by wear it is the wheel that should be worn, consequently it should be made of the softer material; cast iron or steel are better for the screws.

Mr. Horace See, Naval Engineer and Marine Architect, of New York, has applied to a number of large steamers at the East an electric indicator, showing the state of the ship's lights from the wheel house, chart room or other station. From a brief description we infer that there are two lamps in each signal, and if one is deranged the other is lighted, and at the same time there is an audible alarm that continues until the dead lamp is restored.

The Russians do everything on a large scale, even to land reclamation. The Piusk marshes, the reclamation of which was begun in 1887, are as large as Ireland, about 32,000 square miles. 4,000,000 acres were ditched and drained in that year. In 1888, 300,000 acres more were added to the drained area, and 800,000 acres are now under cultivation. This work involved canals and dykes amounting to 120 miles in length, requiring 179 bridges. Our ideas of Russian skill are incorrect. The constructive and engineering

exhibits of Russia at the Centennial Exhibition of 1876 were a matter of astonishment. The models to illustrate mechanical movements, sent from the Technological School at Moscow, were thought worthy of reproduction here, and sets were made by Messrs. William Sellers Co., of Philadelphia, for some of the colleges in this country.

We have watched with a good deal of interest for the report of United States Naval Engineers, Perry and Norton, on the Bellville boilers in the *Northwest.* It will be remembered these engineers were appointed by Commodore Melville to make a trip on this steamer from Buffalo to Duluth, and report on the performance of the boilers, which are of the Bellville (French) type. In the London *Engineer* of Oct. 18th it is stated that the report made was against the boilers, at least claimed they were not suitable for naval service. The words are: "The boilers are condemned, it being the opinion of the officers named that they are not good enough for naval service." This is loose writing, we presume the "they" relates to the boilers and not the officers, also think the report whatever it may be, is one that should have been given out and known. There was no need of going to France for water-tube boilers, or plans for them. The art is no doubt well enough understood here.

Prof. John E. Sweet was appointed as judge of the machine-tool department at the Chicago Exhibition, and made, as we are informed, a full report on the exhibits. If so it has not seen the light to this time. It would be of much use to tool makers, because impartial and intelligent. He has made a special study of iron-working implements, and it is to be regretted that he did not choose this field when he founded a business of his own.

The University of Minnesota has done a wise thing, no doubt, in specializing the subject of locomotive engineering, and has placed this section under the charge of Prof. H. W. Hibbard, who is qualified if any one can be, to conduct the department. The term mechanical engineering as now applied to studies of the constructive arts in our colleges is too wide, and has naturally led to a separation into branches in the later courses, but locomotive engineering, one of the most extensive of all in so far as application, has not before been set off as a special branch, and we think the experiment will prove a great success, at any rate we do not know of anything one can so well recommend to a young man entering upon a course of this study in the technical arts. Trained and proficient locomotive engineers who understand the construction, use and economies of this work are not plenty. The course at the University is practically free, being only $5.00 for registration in the case of students, and $10.00 for graduates in general branches who take the course in locomotive engineering.

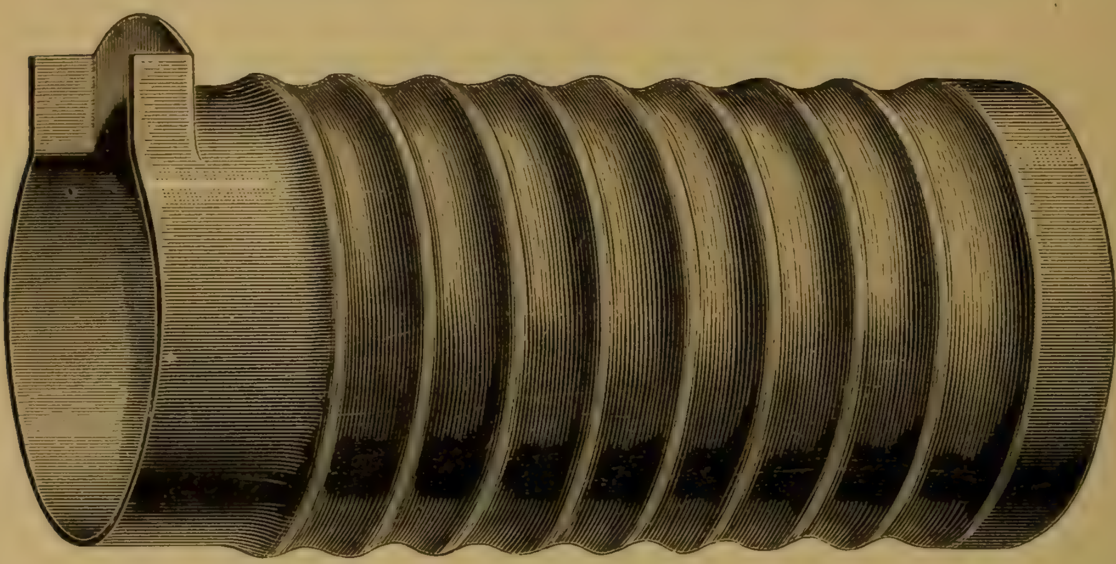
Mr. W. M. Smith, in England, has invented and applied to some locomotives a piston valve that has the important advantage of yielding and permitting the escape of entrapped water, and we wonder that inventors in this country have not been busy in the same direction. The Smith valves are too complicated for description here, farther than to say that the valve collapses or closes inward by water pressure much easier than a common slide valve is lifted from its seat by the same means. Another invention in this same connection, which may or may not be new in this country, is an inlet vacuum valve that when a locomotive is running down grade admits just enough steam to fill the cylinders, keep them lubricated, and avoid sucking in air and ashes through the exhaust way. Both these inventions seem to be very useful and entirely practicable.

There has for several years past been a problem at New York of getting the cable cars out and in at the New York end of the Brooklyn Bridge. The traffic requires at certain times that the cars leave at intervals of 45 seconds, which makes sharp work and requires room. The *Engineering News*, which has some able comments on this matter in a late issue, says the trustees, all but one, are in favor of electric traction on the bridge, and shows that such a scheme is, if not impracticable, very unsuitable. The bridge is about one mile long, and rises 70 feet in the center, so the ascent of the traffic this high would be a dead loss with electric traction. Now it is compensated by the descent of the cars by the cable system, but this is not all. Raising a car or train 70 feet in 45 seconds means that much braking on the descent, and introduces an element of much danger, because the landing or bridge terminal is never clear. A cable spaces the cars, and holds them at equal distances on the down grade. It is not a suitable place for electric traction.

This month brings at least three serious accidents by the breaking of large flywheels, and the future will no doubt furnish the same proportion until there is a limitation of some kind to the methods and material now employed. Cast iron is not a suitable material for such wheels, and is not necessary. We do not say cast wheels, because that is absurd, and has been abandoned for the same reason that cast spokes and rims must be before long. It was something, or indeed a good deal, to be rid of inherent strains due to casting whole wheels. It was going half way, but there will be no immunity from accident until this material is discarded. Methods of construction with fibrous material have advanced so fast that people have not perceived how it can be applied to flywheels. They continue in a rut, bolting up huge masses of cast iron to move at from 60 to 100 feet a second when there is no warrant for such a thing in analogous construction. For example, the lateral or circumferential strain on the shell of a boiler is not different from centrifugal strain on a wheel rim, but no one thinks of making cast-iron boiler shells.

MORISON SUSPENSION FURNACES

FOR LAND AND MARINE BOILERS



Uniform Thickness Easily Cleaned

UNEXCELLED FOR STRENGTH

CORRUGATED FURNACES

SOLE MANUFACTURERS IN THE UNITED STATES

THE CONTINENTAL IRON WORKS

P. O. Station G. BROOKLYN, N. Y.

INCORPORATED 1866

Insures against
Damage to Property,
Loss of Life, and
Personal Injury

CAUSED BY

STEAM BOILER
EXPLOSIONS

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

CHARTER PERPETUAL

J. B. PIERCE, Secretary
J. M. ALLEN, President

ABSTRACT OF STATEMENT
JAN. 1, 1895

Cash Capital,	$500,000.00
Total Assets,	1,955,255.24
Surplus as to Policy-Holders,	693,726.15

PACIFIC COAST DEPARTMENT

MANN & WILSON, General Agents

J. B. WARNER, Chief Inspector

306 Sansome Street - San Francisco, Cal.

The Hon. C. E. Parsons, inventor of the Parsons' impulse steam engine, an engineer of much distinction, we note keeps on inventing propellers to fit his engine, a patent of the kind having been recently granted. We are much afraid he is like most successful engineers in his own profession, very much wanting in the commercial instinct. He will find quite enough to do without taking up propellers, to which in their present form his engines can be easily adapted, besides if he were to invent or adapt a propeller to the high velocity of his engines its introduction would have to be recorded on his tomb. Twenty years would not bring them into use, no matter what their merits might be, besides they lie in a totally different line from his steam machinery. There are many reasons against a high speed of propellers and propeller shafts, compared with which reducing gearing is not an equal evil. A reduction of even the present rate of revolution would be more desirable.

In various exchanges we read extracts from a paper on rope transmission, by Mr. V. Debreuil, before the Society of French Engineers. What for no one can imagine. It is a kind of rudimentary statement, such as a native of Asia might make to his countrymen after a visit to Europe or this country. Here is a quotation: "Three-stranded ropes of manila, hemp or cotton may be used. Hemp is much cheaper than cotton, and usually wears longer, but is less pliable." In criticism of this, why a three-stranded rope? Why is a hemp rope much cheaper when it wears longer? It is not less pliable than cotton, on the contrary, is more pliable, and instead of wearing longer it will not last half as long as the price indicates. The remainder of the paper contains nothing true, not known by every one, and the query is, why is it quoted in this country?

Little by little the makers of wood-working machines are turning to self-feeding saw benches. We can well mind when such machines were laughed at in this country, especially rope-feed benches, which, considering the work done on them, are really very perfect machines. In the abstract one may say there is no more reason for a man pushing a piece against a saw than there is for pushing stuff through a planing machine. It is sometimes argued that the hand feed can be in proportion to the power and sharpness of a saw, but this is a fallacy, because saw teeth like other cutters should displace a certain amount, and not less when dull. We do not reduce the feed when planing knives get dull. Take it all in all, a saw bench, the most common and simple among wood-cutting machines, has the most vices of all, that is, calls for the hardest labor, does the worst work and consumes the most power.

In respect to the "battle of the boilers," now raging in England over the adoption of the French Bellville type for a number of new vessels in the British navy, including two great battle ships, the

government is likely to find themselves in a difficulty over this matter, because if boilers of the water-tube class were required there is no reason why such boilers could not have been designed by makers at home as well as by M. Bellville, especially boilers of this type. The fact of use in the French navy, and in other cases, did not indicate a want of resources in England to produce such boilers, but an opinion that they were not well adapted to marine purposes, except for torpedo boats, hence new inventions were not presented or pressed. What the general result will be is not now clear, we mean in respect to marine water-tube boilers, but one thing is certain, this country has been conservative enough to avoid mistakes.

The Risdon Iron and Locomotive Works, of this City, have constructed a high-pressure line of riveted water pipe for the North Star Mining Co., of Grass Valley, Cal., of which the following are the main particulars:

The pipe is 20 inches in diameter, and 7,000 feet in length. The working pressure at the lower end of the line is 300 pounds per inch. The heaviest plates used were ⅜-inch steel, and the lightest, for 2,500 feet at the head of the pipe line, of No. 9, B. W. G. steel, the pressure on portions of the lighter pipe being 225 pounds per inch. At the lower end of the line is a receiver 24 inches diameter, 40 feet long, the connection to the pipe being made with cast steel flanges. The receiver is provided with a 12-inch branch to a Pelton water wheel, and an 8-inch relief valve. The air chamber is 18 inches diameter by twenty feet long, made of lap-welded pipe, with the ends riveted in. This stands on top of the receiver with a 4-inch connection and shut-off valve. It is also provided wiih an inlet air valve, check valve and water gauge column, including two pressure gauges, reading to 500 pounds.

The material used in the receiver is ⅜-inch mild open-hearth steel, and it will be interesting to engineers to note that when the line was completed, and the test pressure of 400 pounds per square inch applied, the pipe and receiver not only successfully withstood the shock, but they were absolutely tight. It is claimed that this pipe line is working under a heavier pressure than any riveted pipe heretofore constructed on this Coast. The plant at the Risdon Works for making heavy riveted pipe would be a matter of astonishment to our Eastern friends. The riveting, caulking, and even handling, are performed by machinery especially designed for the purpose. Mr. A. D. Foote, who is the consulting engineer for the North Star Mining Company, designed the water plant above described, superintended the construction at the shops and its erection at the North Star Mine.

In foreign journals and in home journals we note a number of examples of electrically-driven elevators, and from these examples draw the comfortable conclusion that the practice in this City is getting a long way ahead. In every example there is the same

winding drums, with a wide face and helical groove to wind one cable for pulling up, and another one to pull down, which we consider decidedly inferior to a traction system that dispenses with the winding drums altogether. Our cable railways are not driven by winding, and could not be because of the positive motion, and for many other reasons. There is no provision for obstruction, and consequently the risk of depending on safety catches, which are unreliable and should be unnecessary. A traction machine that operates by "overhauling" the suspending ropes has in it the true element of safety, besides is not a machine of special construction to fit a particular case. We are waiting, however, to see the result of the screw ball-bearing machine that we had the temerity to condemn on its first appearance.

There has been invented in England an ingenious instrument to indicate the working of steam and other furnaces based upon the amount of carbonic acid that is passing off in the waste gases from the fire. It is an indicating apparatus consisting of two bulbs, one containing rarified air and the other smoke, as it passes from the furnace. These bulbs are balanced on a delicate scale beam which shows at once any rise or fall in the weight of the smoke, which varies with the amount of carbonic acid passing off, determining whether the amount of air being admitted to the furnace is correct or not. It seems a simple and useful idea, but we can see no use for a bulb of air on one side of the balance beam, as any kind of a weight should answer the same purpose. The weight of carbonic acid gas is 50 per cent. greater than common air.

A contemporary notes that an agent from the East has been sent to see if he can make the Fæsch & Piccard governors on the water wheels at Folsom perform properly. The result is no doubt just what inference must point out, that all regulating mechanism for large water wheels of the kind acts too late, that is, the action is sequential. No regulator can control a water wheel through a train of mechanism. We regulate steam engines by governors of one kind or another that act direct, but do not apply the same methods to water wheels, because the governors would require to be as large as the wheels to produce a like result. They are either too slow or too weak, which is much the same thing. If the water-wheel people will attach to their regulating valves, or other water-controlling apparatus, a steam or pneumatic piston to pull a ton, and then apply the regulator to quickly operate the piston, they will have no farther difficulty.

The enormous steam pipes now employed in electric stations and elsewhere are dangerous in a high degree. The large number of accidents at sea are easy to recall, and the same thing or worse will occur on land when pipes grow to the same sizes. The larger a pipe

is the more it will be affected by flexure, or other disturbing causes due to rigid attachment to two or more separate or independent bodies. Flexible joints are nearly impossible under high pressure, and slip joints are dangerous, because of reactive strain, so there seems no hope except in better material, unless the Ferranti system of a group of pipes is practicable. He provided such pipes at Deptford, London, about six years ago, but we have not heard of it since then. In the Italian Navy some pipes have been wire bound for security, but this can only provide against lateral strain, which is not the most dangerous.

The *American Machinist*, of November 7th, has a long account of a Pennington gas or oil engine that is sensational, to use a conservative term, and if the facts are in any degree as set forth the thermo-dynamics of these engines will need overhauling. There are two ignitions, a maintained pressure on the piston speed of 900 revolutions per minute, a piston 2½ inches diameter developing ten horse power, an engine weighing 17½ pounds of 4·75 horse power, with many more startling quantities and dimensions we scarcely dare to repeat. For a little time to come at least we prefer to accept more conservative authorities, especially as we have had occasion before to consider some of Mr. Pennington's revolutionary inventions. Internal combustion engines have come down to their present state of development mainly through the work of scientific men. The contriver has added his part, an important one, as all must admit, but when it comes to bran-new phenomena in combustion, reciprocating motion at 1,800 strokes per minute, and a horse power with four pounds of machinery, the installment is too "heavy." Editor Miller's ominous silence on the subject will be noted by the readers of his journal.

We sometimes wonder how coal gas is so cheaply made and furnished at Glasgow, Scotland, but some recent explanations in *Engineering* puts the matter at rest. The plant for making gas is enormous, and almost automatic. The retorts are filled and emptied by machinery, and all the various processes are conducted in a way to eliminate most of the usual expenses. This is a result of the excellent municipal government of that city, which owns and operates the gas works. When such works belong to private companies, and are monopolies, there is little incentive to improve and cheapen processes because profits do not increase accordingly. If gas is made cheaper, there is danger of lower rates, and the cost of improvement may only be a gain of the public, and no gain to the gas company, hence in many cases at least there is no progress.

Nearly all improvements in butter-making come from the Scandinavian countries, especially from Sweden, where the dairy business is a science. The centrifugal cream separator is an example, so

also methods of churning and treating butter. The three kingdoms, Sweden, Norway and Denmark send into England every year butter to the amount of $35,000,000 out of $70,000,000 worth consumed there or exported again. Now there is to be another change, no doubt, as great as de Laval's separator produced, that of separating and churning at the same operation and at the same rate that separating is now done. The butter is better than if the cream is exposed to "ripen," which on investigation proves to be only a development of microbes, a bit of information not reassuring, to say the least. The machines in common use in Sweden treat 180 to 200 gallons an hour, but larger and smaller sizes are made. Those in want of farther information can address Herr Gustav Salenius, care M. Thorston Nordenfeldt, 8 Rue Auber, Paris.

As we have elsewhere intimated there is a necessity of importing here from the East a numerous line of manufactures, but not steam boilers. There are no steam boilers of the tank kind that cannot be made here as cheaply as in the East, and the work is better done on all kinds of shell boilers at least. In evidence of this, when Galloway tubes were wanted here they were made, and not imported from abroad as we believe they are by Eastern firms. There are certain things, like corrugated furnaces, that no one could afford to put down a plant for making, and there are sectional boilers of the Babcock & Wilcox type, permitting organized manufacture that cannot be made for want of a market wide enough, but all kinds of marine and tank boilers, as well as pipes and plate work, is done as cheaply and better than at the East. A line of riveted water pipe can be made and laid here at a less price than the same work will cost in the Eastern States.

In *Cassiers' Magazine* for December is an article on "Steady Platforms at Sea," in which the writer seems to be unaware of Sir Henry Bessemer's attempts to make such apparatus for the Channel boats crossing from England to France. He first erected in his own grounds, near London, a pit or tank in which was immersed or floated a cabin that was to keep on a level keel irrespective of the motion of the water. A cabin of this kind was then fitted up and put on one of the Channel steamers, but it would not perform automatically, and hydraulic gearing was applied to operate the saloon, and a man stationed to keep it level by hand adjustment. This also failed, and the whole was pulled out and discarded. This was about fifteen years ago.

It is singular that some of the makers of refrigerating machines do not supply small ice machines for hotels and private houses. No doubt such machines are made, but if so they do not seem to find their way out here, where they are especially needed. In England are made small self-contained machines, having all the elements mounted on an iron chamber, that is also a refrigerating box

to contain meat and vegetables. Such machines are very compact, made for use on yachts and other places where there is but little room. They are commonly made with a steam engine, so that the only preparation is to charge them with ammonia and connect to a steam pipe. When not required to make ice, the engine can drive a dynamo, saw wood, churn, wash, and so on.

In answer to frequent inquires respecting the de Laval steam turbine as compared with Parsons' and others, we will say that the difference is the same as that between a pressure turbine water wheel and an impulse one. In the de Laval turbine the effect is produced by the steam impinging against vanes, and in others by interruption to flow or pressure, the steam being confined just as water is in a pressure turbine water wheel. A Girard or tangential water wheel compared to a Jonval, Fourneyron or American turbine will show the difference, but aside from the mode of operation or transfer of energy, it may be called, there is the distinction in the de Laval turbine that the steam is expanded down to atmospheric pressure, or nearly so, before it escapes from the nozzles and comes in contact with the wheel vanes, also the farther distinction that there are no steam-tight running joints to be maintained, as there are no water-tight joints to maintain in an open or impulse water wheel.

ELECTRICITY.

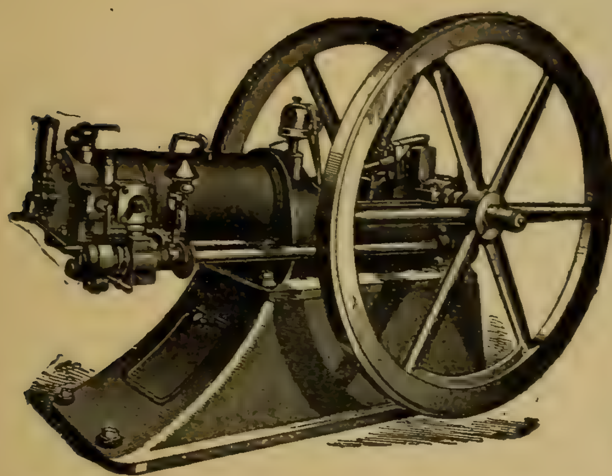
NOTES.

Magnetism of substances depends on some molecular condition not very well understood. If a piece of iron be heated red hot it is no longer magnetic, but inert. This is true of other substances whose molecular condition is changed in a like manner, that is, disturbed and expanded by heat. The effect of lowering temperature, so far as can be gone in that direction, seems to increase rather than diminish the magnetic quality.

The Siemens & Halske Co. have brought suit at Chicago against a railway there operating with a third rail, and the General Electric Co. are defendants. This will be a battle between giants, in which the Siemens & Halske Co. will be at some disadvantage, and may expect acts of cunning and procedure, which they will find difficulty in contending with. We have in this remark, for a precedent, the maneuvers at Chicago in 1893 to prevent the erection of a third rail line at the Exposition. There must be a direct infraction of their supposed rights, otherwise the Siemens & Halske Co. would not venture into the courts to be combatted by all the electric companies in interest.

THE OTTO GAS ENGINE WORKS, Inc.

PHILADELPHIA, PA.



Power FROM GAS OR GASOLINE

Cheaper than Steam.

SIZES:—1 TO 250 HORSE POWER.

Engines built on scientific principles for high Efficiency and Economy.

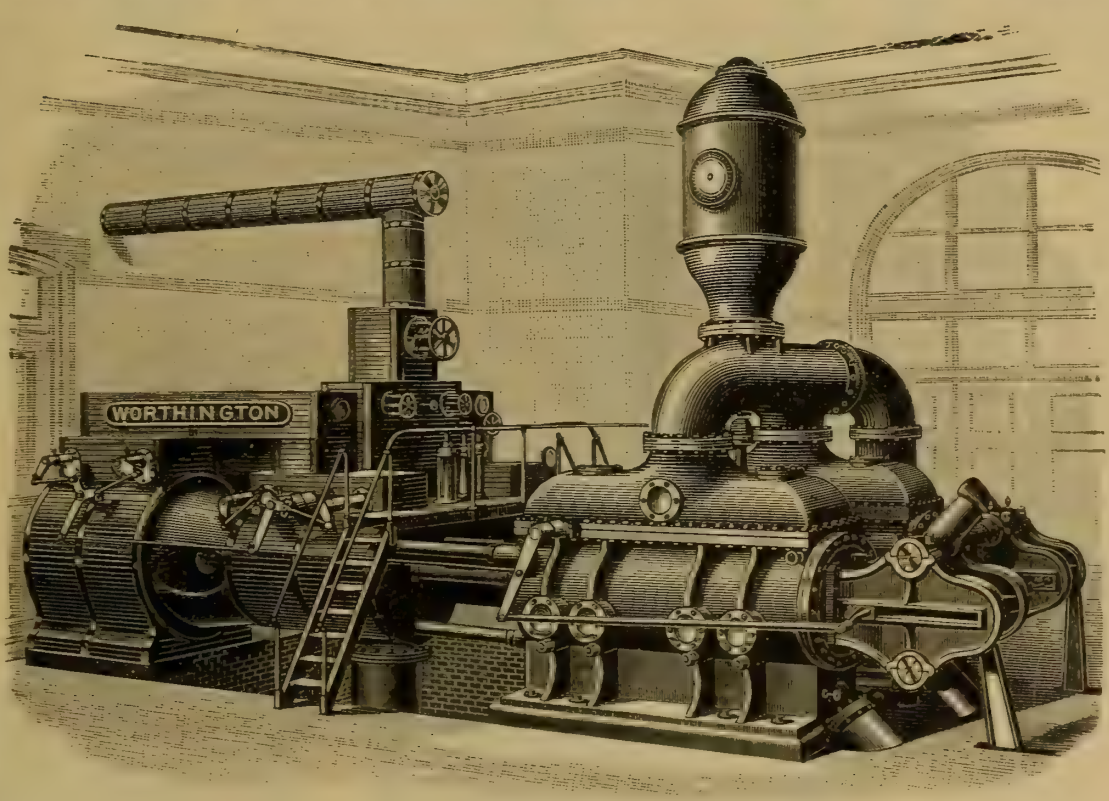
H. P. GREGORY & CO., Agts

2 Medals and 3 Diplomas at Columbian Exhibition.

SAN FRANCISCO and LOS ANGELES.

WORTHINGTON HIGH DUTY PUMPING ENGINES

THESE HIGH DUTY PUMPING ENGINES Have been adopted by the World's Fair Commission to supply all buildings and grounds of Columbian Exposition, Chicago 1893.



THE CONTRACT CAPACITY of Worthington Pumping Engines for Water Works alone to Jan. 1, 1892, **2,585,000,000** Gallons daily, which would afford a stream of water 12 hours per day, 400 feet wide, 5 feet deep, with a current 3.4 miles per hour.

Pumps for all purposes and for any pressure to 8,000 pounds per square inch. The pumps in the Mills Building, Crocker Building, Chronicle Building, Donohue Building, Union Foundry Block, First National Bank Building, Telephone Building, Lick House, Occidental Hotel, and many others in San Francisco, are Worthington.

A. L. FISH, AGENT, 59 AND 61 FIRST ST., S. F.

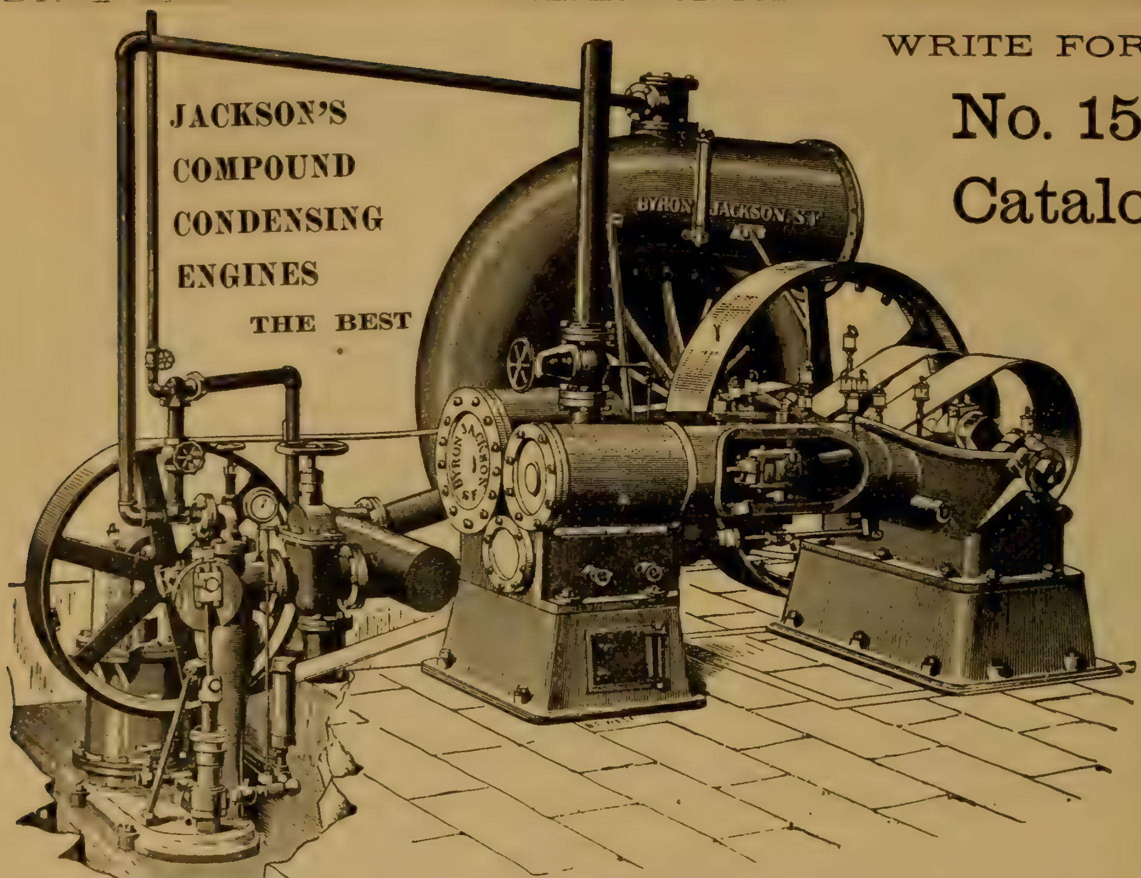
ALSO AGENT FOR THE

AMERICAN FIRE ENGINE Co., which includes Clapp & Jones, Silsby, Ahrens & Button Engines

BUCKEYE AUTOMATIC CUT-OFF ENGINES, of Salem, Ohio

CURTIS' STEAM AND WATER PRESSURE REGULATORS

NATIONAL WATER PURIFYING CO.'S FILTERS



WRITE FOR

No. 15 Catalogue.

JACKSON PUMPING PLANT FOR IRRIGATING AND RECLAIMING LAND.

Byron Jackson Machine Works

625-631 SIXTH ST., SAN FRANCISCO, CAL.

BUILDERS OF

COMPOUND CONDENSING ENGINES

AIR PUMPS AND JET CONDENSERS.

Pumps for Irrigation and Reclamation, Dredging, Wrecking, Mining, and City Water Works.

BOILERS

AND

ANY KIND OF MACHINERY BUILT TO ORDER

These pumps are intended for mine pits or deep wells, and will operate when submerged. The glands and inlets are sealed by water to give full power of the suction. The alignment of parts and for adjustments is perfect. The runner has balancing rings, and sustains the running weights by water pressure, and dispenses with a bottom bearing below the runner. All parts are removable from the top. These are all patented features, and found only in these pumps. The superior efficiency of these pumps has been demonstrated under all conditions of use, and they are sold subject to the broadest of guarantees as to efficiency and durability.

Jackson's Vertical Water-Balanced Runner and Shaft "Whirlpool" Centrifugal Pump.

The Brush Electric Co. have fought other companies over the double-carbon arc lamps at an expense, it is claimed, of more than $150,000. There is little doubt that Brush was the inventor or adopter of the two sets of carbons, but there is a question of this being an invention, so the contest is not directly upon the dual feature, but over the elements that go to make up the whole apparatus. It is claimed that decision in favor of Brush will cost other makers $2,000,000. The first suit in the District Court was against the Brush Company, now it is before the United States Court of Appeals.

There will probably be, early in this year, some important decisions in suits over the Tesla patents, and warnings have been issued by the Westinghouse Company, at Pittsburgh, owners of these patents. One issue will be the multiphase motors, that is, all forms of single-phase motors wherein a second phase is induced, so as to make the same a two-phase induction motor. This is the common type for fans, permitting them to be operated in conjunction with incandescent lamps. We are just now approaching the time when the inventions of value in electric apparatus can be distinguished from the chaff, and there will be legal war between some of the base patents if these are not so smothered up in a world of modification as to be not distinguishable. The public will foot the bills until the patents expire, or are substituted by other means of maintaining prices, which are, however, low enough for lamps.

MINING.

NOTES.

Mr. J. J. Crawford, State Mineralogist of California, has published a tabular chart showing the mineral production of the State for 1894. The table includes metallic and non-metallic products, hydro-carbons, gas and structural materials. Among the notes given are totals of: Manganese, 523 tons; platinum, 100 ounces; gypsum, 2,446 tons; lead, 475 tons; hydraulic cement, 8,000 barrels; sewer pipe, 28,475 tons; antimony, 150 tons; iron, 200 tons; onyx, 500 cubic feet. The total for the State amounted in value to $6,022,681, and including gold and silver, $14,220,613, makes up $20,243,294 for mineral products. The chart shows the product in each county of the State, and forms an interesting study. Copies will be sent free to any citizen of the State who will send two cents for return postage. The title is Bulletin No. 7; and the address 24 Fourth Street, San Francisco.

The Australian Institute of Mining Engineers, have done a graceful thing in electing Mr. Rothwell of the *Engineering and*

Mining Journal, a member of that body. Mr. Rothwell's long and conspicuous connection with the mining industry in this country as well as the world over, entitles him to such distinction. The last meeting of the Institute was held at Hobart, in Tasmania. It is an important Society, with like objects to the American Institute of the same name.

There has been much hue and cry over the speculations in South African gold shares in London, perhaps justifiably, but much depends upon the real fact of value, and after all it may turn out a case of opportunity instead of crazy speculation. The English people are not apt to be gulled by anything capable of investigation, or that is investigated rather. They have lost much in their investments, but commonly by the duplicity of promoters, who proceeded on the system of gorgeous lies and distorted statements. The future production of the South African mines is a problem on which has been brought to bear the highest skill, as we have reason to know on this Coast, from which they have taken a dozen or so of our best mining men. There is, to say the least, strong probability of the gold holding out for many years to come. The main source of loss will be in watered stocks, not in failure of the mines.

The Kootenay Mining District, in British Columbia, has been wonderfully developed in the last five years. There are now forty-eight companies with a nominal capital of 35 millions and continual extension of investment. If the African excitement does not end in disaster, there will no doubt be an enormous extension of mining in the Province, and here as well. Most people imagine, and no doubt a few hope, that the South African mining shares will collapse, but it must be remembered that such a thing will react here, and the mines of this Coast will suffer at the same time, in so far as extension and development. Fifty-four new companies have been registered in California during the present year.

There are an incredible number of ways for gold to escape after it is once procured and weighed. The fumes of melting carry off a good deal, as the "smelting" of the copper roof at the Philadelphia mint some years ago will show. Now comes a story of escape in chlorination processes by the waste solutions, and that at the Carson mint such escape has converted a potato patch into "pay ground;" a cow pasture is included in this statement, but we draw the line inside of that. Gold in suspension, either in solutions or in gases from furnaces, is hard to capture, and the amount, unless measured by time, is too small to be taken into serious account. The potato patch above referred to is said to be worth in gold $11 a ton, but how long the time of saturation is not stated. There is also a problem of how potatoes would thrive when irrigated with a chlorine solution.

Upset Bridge Rods, Truss Rods and Anchors, Turnbuckles, Head and Point Drift Bolts, Wine Cask Bolts with Brass Acorn Nuts, Cold Punched Square and Hexagon Nuts.

All Kinds of General and Special Blacksmithing

P. CAHILL, President. C. I. HALL, Vice-President. JOS. B. KEENAN, Secretary.

CAHILL & HALL ELEVATOR CO.

Electric Elevators

SUPERIOR TO ALL OTHERS

No Winding Drums or Ball Bearings

HALL'S PATENT HYDRO-STEAM SYSTEM

A SIMPLE AND ECONOMICAL SYSTEM

Write for Description or Circulars. Telephone Drumm 57.

Office and Works, 214-218 MISSION ST., S. F., CAL., U. S. A.